PROCEEDINGS

OF THE

SANITARY ASSOCIATION

OF SCOTLAND.

WITH

PAPERS

Read at the Annual Meeting held at Edinburgh, 23rd and 24th September, 1891.

EDITED BY

PETER FYFE, M.I.E.S.S.,
CHIEF SANITARY INSPECTOR, GLASGOW.

PUBLISHED BY
SANITARY ASSOCIATION OF SCOTLAND.
GLASGOW: ALEX. MACDOUGALL, 81 BUCHANAN STREET.
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INTRODUCTION.

The Congress of the Sanitary Association of Scotland, of which this booklet is an outcome, was the most successful of the seventeen which have been held.

The large number of members which took part in it, and the value of the addresses and papers given, were marked features. There can be no doubt that the impetus obtained from the Local Government (Scotland) Act was an important factor in its success. The membership of the Association has been much strengthened by the addition of county representatives, and the future may assuredly be looked forward to, to yield a still greater increase of new and enthusiastic recruits to the ranks. This is the second volume of Transactions which the Association has published in a compact form, and distributed among those who are most likely to have at heart the progress of Scottish Sanitation.

The Association was very fortunate in securing as its President of Congress Dr. Farquharson, M.P., and in numbering among its essayists such men as Dr. Coats and Professor MacFadyean. It is a misfortune that the latter gentleman, who delivered his valuable address chiefly from notes, has not had the time at his command necessary to present the Editor with the text of it; it, therefore, does not appear in this volume, but the thanks of the Association are not the less due to the Professor for his able exposition of the subject of "The Sanitary Control of Milk Supply for Cities." The President's address struck the key-note of our country's sanitary psalm. Every sanitarian in the united kingdom will, we are sure, re-echo his cry for a Minister of Public Health—for some head to guide and control—for one man who "should be made responsible for preventable disasters."

From the Presidential Chair Dr. Farquharson has spoken in earnest. The almost unanimous voice of the country has urged the various Parliaments since 1848 to the consideration and completion of enactments dealing with the health of its inhabitants. Now we have on the statute records of England, Scotland, and Ireland, both on general and local lines, such a mass of sanitary legislation as may well occupy the whole time and attention of a special Minister and a Central Sanitary Bureau. Instead of this we are still suffering from the lame expedient of trying to supervise and control this vast and increasing machinery through the Local Government Board, whose work is already of such a multifarious and laborious character, that only one-eighth or one-ninth part of its attention is available for sanitary purposes. We would deprecate, along with Dr. Farquharson, any "fussy and meddling interference with healthy municipal and local life" by any Minister of Public Health or his visiting representatives, yet we are convinced that throughout our country there are several Local Authorities whose torpidity in sanitary movement is injurious, and can only be checked and changed by the strong and energetic hand of an experienced Minister invested with sufficient power. Medical and sanitary officers in Scotland could tell, if they chose, many a story of sanitary work of vital consequence to health and life not only remaining undone, but practically forbidden to be done by their respective Local Authorities. When the paymaster forbids, the servant must be silent or suffer. There have been more martyrs in the cause of sanitation than past Governments or Local Government Boards have had any direct knowledge of—martyrs to crass ignorance, to vested interest, to severe economy. Now that a special Government Board has been established to narrowly watch over the health of the "beasts that perish," we may with every confidence await the advent of the first Minister in whose keeping will be the health, comfort, and well-being of men, women, and children. The Members of Parliament who first impress the importance of this on the Government, and cause action towards the establishment of a Health Minister to be taken, will be remembered as public benefactors as long as disease, and filthiness, and ignorance exist in the land.

The paper by the County Sanitary Inspector of Ross-shire

contains many valuable suggestions, and at its commencement discusses the difficult problem of providing adequate and convenient hospital accommodation for our rural population. After careful consideration of the matter, Mr. Mackenzie says he sees nothing for it but impressing strongly upon the respective authorities the necessity for proper and adequate hospital accommodation within the different districts. It is plain, if the population of our one and two apartment houses in the country districts are to be saved from infectious disease, when it does come to their homes, it must be by immediate removal of the patient to some hospital. To farmers throughout the country the want of a hospital means the responsibility of treating the infected case at the farm, and constant fear to them of contamination of the milk. In many cases this home treatment has been proved to have resulted in illness and death to the consumers in town receiving their milk supplies. The whole question cannot be too much discussed, and the Association are indebted to Mr. Mackenzie (who, by the way, is an architect) for placing it before them.

Dr. Coats' paper on "Tuberculosis viewed as an Infectious Disease: its Prevalence and the Frequency of Recovery from it," is one of those trumpet-toned announcements which every intelligent member of the community should hear and carefully ponder. It was somewhat of a fortuitous coincidence that three of the papers submitted to the Congress should have dealt largely with the vexed subject of tuberculosis. The President of the Association showed how comparatively little has been done by sanitation to reduce the ravages of this disease in Scotland during the past thirty-three years; Dr. Coats emphasised this, and pointed out that probably 22 per cent of all the deaths in the country are due to it; that *one-half* of all the persons born are, in some form or another, affected by it before they die. He pointed to the most likely causes of its general prevalence, and expressed his earnest feeling that the question of its notification, the isolation of its victims, and the disinfection of their environment and belongings should be seriously discussed, while Professor MacFadyean clearly showed how the closely confined, ill-housed, carelessly kept cow became a veritable producer of the bacilli which breed the plague in mankind. We doubt not that these papers will bear good results in the future. The whole question is a vast and difficult one, pregnant with trouble to the statesman,

anxiety to all local authorities, and future pain to all families interested in tuberculous patients.

Dr. Eben. Duncan's paper is a heavy and convincing indictment of the Department of the Registrar-General of Scotland. It appears from the facts he presents that the statistical information supplied by this department are sadly wanting in completeness, and are, in fact, of little value to the inquiring sanitarian. The bare statement "that with regard to two-thirds of the population of Scotland, we are not furnished with any details as to the causes of death in the detailed abstracts," is sufficient to show the cheese-paring that is going on in our Scottish Registration Department. He informs us also that no comparative rates of death, nor mortality tables showing the causes of death among the members of various professions and trades, are attempted, and that we must rely on England for any such information. The want of a Decennial Supplement is remarked upon. It is surely desirable that such funds be allocated to this most important branch of the national service as will enable the Scottish Registrar-General to prevent in the future the possibility of such criticism. Dr. Farquharson intimated that Dr. Cameron, along with himself and one or two others, would have something to say in the House of Commons on the subject when the estimates came to be considered.

The vexed question of the proper disposal of village sewage is discussed by Mr. Watson, the County Inspector of Aberdeenshire. This is a subject of the highest importance to all members of County Councils and their sanitary officers. Many are the small rivers and streams in Scotland which are converted into open sewers by the drains of various villages and hamlets along their course vomiting their foul contents into them. From information which Mr. Watson obtained from 182 Local Authorities, it seems that only 82 attempt anything in the direction of purification, or the elimination of the solid matter from their sewage before it is run into the natural water-courses. In view of this, he remarks that neither the Local Government Board nor the Board of Supervision appear to be active in causing Local Authorities to carry out the provisions of the Rivers Pollution Act. We are afraid County Councils will not be in any haste to reform matters in this direction, unless it can be brought home to them that the contaminated stream is actually a source of

public danger, and it may be safely presumed the Board of Supervision will not interfere simply because such practices are illegal. The whole question of village disposal of sewage mainly hinges on finance. Little effectual work in this direction can be accomplished by a District Council without materially increasing the rates on the inhabitants within the special drainage district. Until disease can be distinctly traced to a polluted stream used by man and beast, many County Councillors may be pleased to ignore the pollution, and retain their popularity as "ratepayers' candidates."

No comment is required on Mr. Scott's paper on the "National Registration of Plumbers." It speaks for itself. The Association willingly agreed to assist in the movement, and have sent a petition to Parliament in favour of the scheme.

Dr. Milroy's contribution on "How Typhoid Fever Spreads" is a valuable one. It emphasises in a most decided manner the lesson which has often been taught before—viz., that impure water for domestic purposes is always dangerous, and very often deadly.

In closing, we express the hope that this effort of the Association to lay before those interested in sanitation in Scotland the latest thoughts and utterances of some of its prominent members, will be of service in advancing the cause of public health. The day cannot be far distant when Scotland will be blessed by the launching by Government of a new and comprehensive Health Act. When that day arrives every individual member of her various Local Authorities should be able to lend active and intelligent aid in advancing the measure, and enhance their aid by a warm and united enthusiasm.

ON A MODEL HYGIENIC STATE; OR, A GLANCE AT THE SANITATION OF THE FUTURE.

By ROBERT FARQUHARSON, Esq., M.D., M.P.

In casting about for some ideas to set before you on this important occasion, I came upon the relics of a long-forgotten controversy stowed away in an obscure corner of my brain. Many of you will remember how keenly we debated in bygone years the question whether "life is worth living," and how curious and varied the answers were. Some of those who set themselves to consider seriously the problems of existence, undoubtedly came to the conclusion that their entrance into this world was a mistake, that there was nothing good nor useful to be done here under the present constitution of society, and that the sooner they cleared themselves out of the way, and tried what the great unknowable could do for them, the better. But I cannot remember to have seen that the bills of mortality showed these *blasé* philosophers to be possessed of the real courage of their opinions, and that any sudden and alarming increase in the annual list of suicides proved a sincere desire on their part to exchange the discomforts of this life for the uncertainties of the next. Perhaps a judicious dose or two of blue pill may have changed the colour of their horizon; perhaps, and more probably, they continue to hug their shadowy grievances until they have almost convinced themselves of their actual existence, and to introduce them to their friends, and even to their merest acquaintances, on the smallest possible provocation. Others, who include, I should imagine, the majority of mankind, whilst by no means convinced of the perfection of their own status in the world, and clearing their mental atmosphere from time to time with a good grumble at the better fortune of others, would make reply that, taken as a whole, life is a good thing, and well worth living.

The minority, whose lips the silver spoon has never touched, either at birth, or in the dismal years to come, might well pause before making a dogmatic answer. Poverty, starvation, pain, disease, and every form of human misery would seem to conspire to make them long for the day when their sufferings will be at an end, and their spirits released from the wretched framework which mocks the bare possibility of happiness. But in the midst of all this squalor and dreary depression the silver lining of hope peeps through the edge of the leaden cloud, and if the dread summons to quit this world were to come even at the darkest moment of life, I believe there are very few who would not eagerly grasp at the chance of a reprieve, however short—and it is in view of this reprieve that we are more or less consciously shaping our lives. It is probably more by instinct than by knowledge that we follow the laws of nature which have been formed for our guidance, and which cannot be broken without heavy penalty. We eat when we are hungry, and get the most wholesome food we can afford; we drink when we are thirsty, unhappily too often when we are not; we clothe ourselves according to the seasons, and we see that our houses are in good order, below as well as above ground. By these precautions we hope not only, following old Cullen's phrase, to obviate the tendency to death, but to make the period of life itself happier and brighter, and more useful to ourselves and others. A contented disposition may be the fairy godmother's gift of temperament, but it may be largely due to a good digestion, and the easily acquired habit of not worrying about trifles, and of habitually looking on the bright side of the shield; for much vice as well as disease is due to unwholesome sanitary surroundings. Bad air leads to depression, and depression leads to drink, and the intolerable monotony and tedium of many people's lives almost excuse an occasional bout of dissipation, and the public-house becomes to the poor man what his club is to the rich—a place where he can enjoy cheerful society, and forget the little sordid worries and anxieties of domestic life.

Now, this is all very well, and we can doubtless do a great deal to secure our own health and comfort if we are wealthy enough to arrange everything around us by sanitary rule, and knowing enough to see that our orders are carried out. But even when we have done the best we can for ourselves, individually and collectively, the disheartening reality is borne in upon us from time to time, in the most cruelly practical fashion, that the ignorance or avarice of others may cut short with peremptory abruptness an existence which we have been at so much pains to prolong. A mouthful of tainted meat, a morsel of decomposed cheese, a draught of infected water, a crack in a drain pipe, or a defective trap, may make our "best laid schemes gang aft a-gley," and kill us in some painful and lingering way without even

the doubtful consolation that the vengeance of the law will exact some heavy penalty from our assassin. I was reading a peculiarly painful case of this kind the other day, and it is only one out of many. A worthy Aberdonian had gone to London to take up an important post in a bank. For the sake of his family he wished to live in the suburbs, and was attracted by a cheerful and commodious house in a pleasant neighbourhood, reasonably near his work. He was assured that all the sanitary arrangements were in perfect order, and for the first few weeks everything went well. But then one child sickened with diphtheria and died, and then a second, and then a third, and finally the fourth and last and his wife were smitten down, and followed the others into the silent land, and the poor man was left to pursue his solitary way. When enquiry was made into the cause of these disasters, a long rent was found in a pipe connected with the main sewer, and through whieh sewer gas freely bubbled into the water supply, and killed its victims with all the certainty and nearly all the swiftness of prussic acid or arsenic. Now, some one should be made responsible for preventible disasters—I will not call them accidents—like this, and it will be my business to explain to you the machinery later on. For although the science of hygiene is advancing by leaps and bounds—and more especially during the Victorian era the progress in this, as in other good works, has been most remarkable—much still remains to be done. I shall presently invoke the aid of this influential Congress in support of one or two points which may help, I venture to think, our onward movement. But before going into the future, will you allow me as briefly as possible to glance at the past, and to stand for a moment on the table-land of the present? And for what I have to tell you I have to thank very largely that illustrious scientist, Sir John Simon, whose recently published work, entitled *English Sanitary Institutions*, may be regarded as the summing up of the work of a long life directed to the good of mankind, and to the perfecting of those hygienic laws with which his name and fame will ever be imperishably associated. I can imagine nothing more satisfactory, at the end of a period of productive usefulness, than to sit quietly down and see the further progress of Science shaping those ends which we have rough hewn in our own younger days, and Sir John, perhaps more than any other man, next to Chadwick, deserves the credit of having contributed to the best progress of our age by helpful and suggestive advice, as well as solid and actual fulfilment.

Now, however much weavers of romance may light up with their rosy tints the faded glories of what some people still persist in calling the good old times, Sir John Simon's graphic pen rubs away the rich and mellowed varnish of antiquity, and shows us the real picture in its crude nakedness; and all of us must feel,

as we turn over its pages, that we are lucky indeed to have had our lines cast in pleasanter places. The clash of steel and the glitter of arms, and the lists and the battlefield, and the merry green wood, when the bay of hound and the twang of the horn led up to the night of joyous revelry, are touched into living reality by the magic pen of Scott, and our jog-trot times may seem sadly drab and colourless by contrast. But follow these gay gallants to their dreary and cheerless homes, and if the gorgeous knight had to stow away his household gods in the hard and barely furnished castle, what must have been the life of the serf or peasant? What abject misery, what utter disregard of nature's laws and sanitary appliance, what disease, what mortality. Nor were things one whit better in the large towns. The London of these times was a mere hotbed of pestilence—narrow alleys and noisesome irregular passages kept out air and light, and the rickety erections of wood and plaster which passed for houses were not only built on foundations of accumulated filth, but contained within their four walls "an infinity of frowsiness and infection" which must have gladdened the hearts of the microbe of the period. Changed days now for these unhappy germs, tracked about from place to place, routed out from their dark corners by the bull's-eye lantern of scientists, ordered to move on from their happy hunting-grounds, and starved and held up to execration as the destroyers of mankind, their lot cannot now be a happy one. But centuries ago they ran riot undisturbed, because unsuspected; and during their unrestricted reign the inhabitants of merry England must have had a pretty bad time of it. Plague, leprosy, scurvy, ague, small-pox, and a host of deadly and disabling diseases defied the doctor's art, cut down the population with epidemic swiftness, and stunted or maimed the lives of those who were spared. And until the great purification by fire in 1665-66 little or no improvement followed the nibbling at the fringe of the sanitary evils of the time by drastic edicts and ferocious laws. We can understand the terror and despair which ran through the town during the clearance of 436 acres, including 400 streets and 13,200 dwelling-houses, and how faint a gleam of hope can have penetrated the heavy atmosphere of ruin and destruction which hung over the smoking ashes of so many homes. But unmixed good soon shone out of the temporary evil. The plague slunk away to do its dreadful work elsewhere. The genius of Wren, cribbed and confined though it was by short-sighted parsimony, soon constructed a new city as superior to that which preceded it as the London of to-day is to the Metropolis which doubtless was looked upon as close upon perfection by the honest burghers, who trod its badly paved streets and sniffed its more than doubtful atmosphere, in the days of the Stewarts and our early Hanoverian monarchs; and a fresh, shall I rather say a new, impulse had now been given to sanitation. Mead, Pringle,

Lind, Blane, Baker, Jenner, and Howard contributed their epoch-making labours to the progress of the age; and the individual contributions of these fathers of preventive medicine were seconded, if somewhat languidly, by the co-ordinatory influence of the State, whipped up into spasmodic energy from time to time by the terrible warnings of cholera invasion. But the real foundations of our present edifice of Hygeia were laid, and the structure partially completed during a definite period of our history; and the half century of rule of our beloved Queen has been conspicuous, among numberless other benefits, for the rapid progress made in the science of prolonging the lives of her people, and adding to their comfort and happiness as well as to their freedom and intellectual growth; and the first ten years of that reign, which were not only productive of much direct and obvious benefit, but were the seed-time before the abundant harvest of later days, must ever be associated with the persevering and self-denying labours of one man. Sir Edwin Chadwick, to whose life and labours your last year's president, Dr. Cameron, paid a worthy tribute, toiled on with devoted and strenuous energy into an age far beyond the allotted life of man, and when ninety years had rolled over his head, Government suddenly seemed to wake up to the consciousness that such a man was still on the face of the earth, and extended to him the tardy recognition of a K.C.B. Chadwick essentially belonged to the fighting class of reformers. He did not spare the tender corns of his opponents, and it is just possible that, with greater powers of conciliation, and with something more of the tact and *savoir faire* of the diplomatist, he might have accomplished more than he did. But he might have lost more than he gained. We, at all events, should not have profited by his resistless force and contagious enthusiasm, his initiation, his suggestive power of projecting his mind into the future, and divining, by a kind of subtile intuition, what had to be done for the health of the world, and how. But time will not allow me to dwell further on the career of this remarkable man, to trace his precise influence on the sanitary history of his time, or to do more than enumerate in brief sequence what others have done in the same field. How the Local Government Board was constructed. How its first medical adviser, Sir John Simon, devised much of the machinery of its hygienic work, and issued year by year those classical reports which have done so much to advance our knowledge and cultivate the scientific way of regarding the subjects of which they treat. How his worthy successor, Buchanan, keeps up the same high standard of progressive achievement and literary finish, and how Barry, and Powell, and Parsons, and Thorne, and Ballard, and others working under him, have carried their detective sagacity with real genius far forward towards the solving of the intricate problems that are set them to unravel. And now, pausing for a moment to take breath after this rapid

survey, let me ask myself and you whether we have yet reached perfection, whether we have profited to the full by the experience of the ages, or whether there still remains something for us to accomplish. I have a very definite opinion on this point, and shall now place it before you for your consideration and possible approval.

Now, to begin with, I wish to say that the foundation of all effective progress in preventive medicine must be education. By this I do not mean the vague smattering of general principles which may be dropped into a child's ear at a Board school, though I am far from undervaluing the possibilities of awakening in this way some sense of the responsibilities which we owe to ourselves and our neighbours. But a far more effective, because more real and more lasting method of bringing these questions home to the public mind, would be the influence, partly insensible and partly openly observed, of a series of object lessons carried on in every locality by experts stationed there for the purpose. I do not for one moment wish to withhold my appreciation of the excellent work done by medical officers of health in the past, considering their power and opportunities. But it must be evident that a man not specially trained in sanitary science, who is so miserably paid as to be almost entirely dependent on private practice, and who holds his appointment on a fragile tenure, neither can nor will attempt much in the way of drastic reform. Things are no doubt a little better now, and county councils have introduced a better regulated hygienic machinery into our localities, and have, in Scotland at all events, been compelled in all cases to appoint, by combination or otherwise, scientific professional advisers in every district. But the stipends paid are still far too small to attract the class of men who are needed—men of high natural intelligence, of careful scientific training, invested with the independent authority which is created by a strong and sure position. By their personal influence, by the efforts which they would undoubtedly make to infect their neighbours with their own enthusiasm, and, best of all, by the quiet influence and example of their work, they would at last enlist a strong contingent of public opinion to help them to overcome the obstructive influences of passing officialism, and to march onwards in the direction of progress. But then effective help must also be ready at headquarters when required. By this I do not mean fussy and meddling interference with that healthy municipal and local life which, under the beneficent influence of the Local Government Act, has conferred so large an instalment of home rule in Great Britain. But it is obvious that small and scattered bodies, however efficiently they may be doing their work, and however well they may be backed up by the larger councils in more important centres, cannot fail now and then to need some influential backing, some advice, and

some of that encouragement which depends on direct knowledge and supervision of what has actually been accomplished. The medical officer of health, toiling patiently on in some remote district, or fighting the battle against preventible disease in our large towns, would naturally derive infinite help and stimulus from an occasional visit to headquarters, or from the call of one of the peripatetic inspectors from the central office; and those who constitute the organizing and initiating brain to which these various cords of intellectual force converge, would with equal certainty depend in large measure for their plans of co-ordination and hygienic campaign on the various reports which they receive, and the suggestive comments and reflections which various acute minds working locally, have to make on the facts coming under their direct observation. But is the central authority, as at present constituted, able to do this? Hardly, it seems to me, so long as public health is merely a bit, and not in the eye of Parliament the most important bit, of another department. It is not so long since education and agriculture were mixed up together, and when one and the same minister had to detach his mind with well-trained elasticity from the Sixth Standard to foot and mouth disease, and from the mysteries of rinderpest to the threatened incidence of over-pressure in our board schools. Happily in these later days a decree *nisi* has been pronounced, and the formerly ill-assorted and now divorced pair can now go on their separate way rejoicing, to their own mutual benefit, and to the advantage of the country. And, short as the time is that has elapsed since the formation of the Board of Agriculture, no one can deny that really good work has been accomplished, and that a decided impulse has been given to the science over which it presides. If this has been done for pigs and swine, for cattle, and horses, and ears of corn, why not for human beings? When the sister arts of destroying human life are represented in the House of Commons by a brace of ministers drawing £5,000 a year apiece, and playing games of brag with foreign powers to the tune of some 25 millions, why should we tack on the study of the best means of promoting longevity, and conferring on the actual workers of the world that animal vigour, without which success is impossible, to the skirts of the Local Government Board? Mr. Ritchie and his office have the control of the machinery and finance of municipal service, of poor law, and conservancy of rivers and lands, and registration, and census, and geological surveys, and other things, which are surely enough to occupy, usefully, one man's attention. Let him stick to them, and hand over the affairs of public health to a distinct and separate department, whose chief should have a seat in the House, and even in the Cabinet, and have supreme jurisdiction over an extensive and well ordered Intelligence Bureau. Nothing can be better of its kind than the work

embodied every year in the reports of Dr. Buchanan's office. Conceived in the highest scientific spirit, it is carried out with a zeal, and skill, and patience which are the admiration of hygienic authorities all over the world, but there is far too little of it. What we want is a little army of experts and inspectors who are not obliged to wait for orders from a bureaucratic network of red tape before they can set their machinery in motion, but who are always working well ahead, investigating causes, devising means for prevention, and giving active and practical help to every line of research which has any bearing on their proper lines of progress. The rate of scientific movement is at present enormously rapid, but it is almost exclusively worked by private hands; and although no one would wish to limit or discourage the advance of individual effort, I do hold to the belief that Government should do more than it ever has done to help those who are thus so effectually helping themselves and others. A strong department, such as I have sketched, would not only initiate and carry out independent lines of research, but would aid and subsidize those who were proceeding in parallel directions, and would, by their authority, induce successive Governments to reduce, with something like reasonable promptitude, the settled facts of science to practical application. But the education, of which I spoke some time ago, will be necessary here, and can best be carried out by a strong centralized body working in serene harmony with well organized local effort. I cannot believe that civilized human beings will much longer submit without dissent to be massacred every year in large numbers by diseases which depend sometimes for their origin, and always for their spread, on absolutely preventible causes; that they will consent to be poisoned by germ-laden water, or that they will continue to inhale, with docile submission to some supposed inevitable law of nature, air contaminated with unconsumed soot. Above all, that they will not only cease to bear these depressing miseries without revolt, but that they will demand the summary application of swift and sure penalties on those who, by their ignorance, obstinacy, or avarice, either terminate our existence with premature cruelty, or deprive life of much that makes it worth living. When that day comes, as come it must before long, obstruction and timidity and false notions of personal liberty and individual rights must give way, and the interest of the general community will enforce the maxim, *Sanitas sanitatum, omnia sanitas.* The scheme of government, which I have sketched out, and which has commended itself to the minds of many of our best reformers, will cost money, but the investment will be a good one. My predecessor in this chair devoted a large part of his excellent address to the economics of public health, and to the value of liberal and judicious expenditure on this peaceful and domestic department of the state.

Up to this point I have sketched in somewhat bare outline an impressionist idea of what I think the sanitary legislation of the future may be. Let me now set my palette with appropriate colours, and placing the works of my predecessors before me, see what I can do in the way of producing a more finished picture. And here let me acknowledge an especial debt of gratitude to Richardson, whose *Ministry of Health and Hygeia* has been of immense service to me, and has shown to all of us what effective and practical outcome there may be of the scientific use of the imagination.

Let us then begin from the very foundation, and take a glance at the conditions under which the contagium of infective processes takes its origin and does its work. Some disorders breed out of dirt and decomposition, and overcrowding and under-feeding, and our business as sanitarians must be to check their generation, or to nip them in the bud if the seeds are planted or show an inclination to sprout. So we must scrub and cleanse, and let in light and air, and force out bad smells if they are allowed to collect at all, flush and ventilate our sewers, and keep all noxious matters busily moving on until the resting place is reached, where they may be deposited in safety. Civilization has at all events played us this bad turn, that the perfection and comparative complexity of our modern systems of drainage become a perilously successful machinery for the propagation of disease if anything goes wrong. It would seem a serious matter to place our dwelling-houses in direct communication with large reservoirs of foul gas, and to interpose between the manufacture of poison and the nose of the occupier some trap, or valve, or pipe, so fragile and so well concealed, that fatal damage may have been done long before suspicion has been aroused. The remedy for this is two-fold and obvious. First, place the direct and undivided responsibility on some one to see that the network of precaution is always in perfect working order; and with this object in view, I should enforce the strict regulation that every one who sells or lets a house should give the lessee ample assurance, on the authority of an expert, that all the sanitary appliances are sound and good, and up to the reasonable requirements of modern science. And second, that drains should be of such moderate size that they do little more than accommodate the actual amount of material which they are constructed to hold, that they should be very freely ventilated, and that ample flow and flushing should provide for a steady clearing away of their contents towards the outfall. For it is one of the elementary axioms of sanitary science that perfectly fresh sewage does nobody any harm, and that it is only when it is allowed to seethe and fester in dark corners and stagnant pools that noxious emanations and infective properties become actively developed life-destroying processes of disease. What is to be done with the sewage matter when it leaves the

drain is one of the biggest, yet still most rapidly growing, questions of the present day. In addition to contaminating our rivers and endangering our water supply, is it the case that we are annually throwing away enough manurial wealth to double, or at least largely increase, our food supplies? The popularity of sewage farms is undoubtedly increasing, and most of the large English as well as some of the Scotch towns are now availing themselves of this convenient solution of a difficult problem. I am rather sceptical about the pecuniary success of this phase of agriculture, and I am not aware that statistics have borne out the sanguine expectations of those who hoped to reap a rich harvest of profit from the utilization of waste lands by the contents of our *cloacæ maximæ;* but there can be no doubt about their complete sanitary success.

I was very much struck by the case of Wolverhampton which came before the Police and Sanitary Committee during the past session of Parliament, and where a large mass of sewage was treated partly by chemical means and partly by irrigation, so successfully, that the effluent which eventually flowed into the river was described by one scientific witness as of superior quality to the water which the inhabitants of London are sometimes called upon to drink.

By very strict superintendence of these elementary sanitary conditions, we may hope to stamp out all those diseases which depend on dirt for their origin and spread. Better housing has practically abolished typhus; better feeding has made relapsing fever almost historical; better draining must root out typhoid and diphtheria. But we now come to another class of maladies whose origin is more obscure. Whether we have also the art of manufacturing them or not, whether they construct themselves by some process of evolution out of very humble beginnings which we cannot yet trace, are questions for future solution. But it is suggestive to note that Miss Nightingale says that she has seen and smelt small-pox spring up *de novo*, that Dr. Carpenter associates scarlet fever with the refuse of slaughter-houses, and that some other observer thinks that he has traced outbreaks of measles to damp and decaying straw. I confess myself to be a little doubtful about the evidence in favour of these alleged facts; but it is much more likely to be true that we may get scarlet fever from cows and diphtheria from cats, and that the working out of the connection between the diseases of the lower animals and our own will eventually attain to results of the highest importance to both. But, however this may be, our duty is to diagnose early, to notify and to isolate effectually, as well as to treat. It is probable that future investigation may give us the means of detecting these disorders in their non-infective incubation period, and that the means thereafter to be taken may actually improve them out of existence altogether. Notification,

thanks largely to the able and persevering advocacy of Dr. Littlejohn, has now become thoroughly popularized as a means of dealing with infection. The dismal croakings of pessimists have merely ruined their own prophetic reputation, and it only requires to be made compulsory to extend it to the few large towns and localities which have not yet had the courage to take the plunge. But, without larger powers of isolation than now exist, notification will only be a partial remedy. Here, however, greater difficulties must arise. The Englishman's house is his castle, and he is apt to resent interference with his domestic arrangements; but reflection and education will surely come to our aid in time, and show the immense benefits to those in contact with infected people, if they can shake themselves clear of the probabilities of transmission. For not only should the actually diseased people be removed, but those who live under the same roof should also be transported to some safe and airy place until their period of quarantine is over, and vigorous disinfective precautions have meanwhile been vigorously enforced by the sanitary authority at the public charge; and in this connection I was sorry that an excellent clause in the recent Edinburgh Bill, by which all the inhabitants of an infected tenement should be cleared out to country quarters provided for them by the town, was rejected by the Committee of the House of Commons before which it came. But the very Radical town of Leicester has voluntarily adopted most drastic regulations for the compulsory removal of small-pox patients to isolation hospitals, and it is to be hoped that some future ministry may have the pluck to imitate that which carried out to the strict letter the famous recommendations of Mead, made in face of a plague epidemic in 1720. Let me read to you some of his own graphic words:—"Understanding and diligent men, wherever the distemper breaks out, should, without delay, order all the families in which the sickness is, to be removed—the sick to different places from the sound; but the houses of both should be three or four miles out of town, and the sound people should be stripped of all their clothes, and washed and shaved, before they go into their new lodgings. These removals ought to be made in the night, when the streets are clear of people, which will prevent all danger of spreading the infection. And, besides, all possible care should be taken to provide such means of conveyance for the sick, that they may receive no injury. All expenses should be paid by the public, and no charges should be thought great which are counterbalanced by the saving of a nation from the greatest of calamities."

The County Councils in the various districts would have control over all these matters, and would be advised and directed by their medical officers of health. These important people would then have their authority duly recognized, for they would be a well paid, prosperous, and respected body of men, working in

harmony with the practising medical profession, regarded as the friends and advisers of the inhabitants of their districts, and invested by a wholesome public opinion set in motion by their sanitary boards for the due carrying out of improvements. For when the nation becomes really aware how much disease is absolutely preventible, and how much more it may be deprived of its danger by increasing the power of resistance of the human frame, they will insist that their rules shall give them as effectual protection against this kind of invasion as a strong navy is supposed to confer on our shores. It is probable that every disease has its own special germ or bacillus, and from the beautiful researches of Metschnikoff, we know that their effective entrance into our system is stoutly opposed by the phagocytes or white blood corpuscles, which wage relentless war against the intruder. Some people seem to bear charmed lives, and however much they may be exposed to infection, to use a familiar phrase, "they never catch anything." This means, of course, that all the forces of resistance are well organized, that the nervous system is not easily overborne by depressing influences, that the red blood corpuscles are well supplied with oxygen, and that their amœboid brethren are at their posts, strong and active, and eager for the fray. We do not know yet what special causes contribute to confer on these vigilant warriors their full fighting power, but it is reasonable to suppose that whatever braces up the constitution generally will also have a tonic influence on them. And thus we see the direct bearing that good air, and good food, and serenity of mind must have in enabling us to withstand the assaults of the bacillary invaders who are perpetually floating in the air, and looking out for every convenient opportunity of entering our citadel, and entrenching themselves behind their own line of fortifications in their own appropriate territory.

In matters of doubt and difficulty appeal can be made from the district councils to the larger bodies sitting in the centres, and they, again, can refer, when they want encouragement and advice and increased power, to the head centre of all, installed in high office up in London. And their duties will necessarily be of a highly responsible and wide-reaching kind. They must co-ordinate and investigate, and suggest, and generalize; they must have specialists of many kinds and in ample number at their command; they must have sufficient funds for the maintenance of chemical and physiological laboratories, of an institute of preventive medicine, and they must be in frequent communication with other departments; they must help the veterinarians to establish the connection between the diseases of man and the lower animals; they must advise the Home Office and the Board of Trade, and the Army and Navy, and by their tactful and gradual way of initiating reforms, prejudice will be removed, interest stimulated, and the importance and real dignity of the

study of public health will assert their rightful position in the economy of public and domestic life.

The minister who takes charge of this new department will necessarily occupy a position of great authority and prominence. For not only will he be the direct representative of the health department of the Local Government Board, but he will weave into one connected web various scattered threads of health administration which can be picked up in other offices around Downing Street and Whitehall. Thus, the Home Secretary regulates factory legislation, mines, the police prisons, and various matters having a direct bearing on sanitary requirements. The Board of Trade is in charge of the mercantile marine and other important services; the Foreign and the Colonial Offices all have their little bits of sanitary work, which would be joyfully annexed by the minister of health. Dr. Richardson, with the distrust of party government, which is shared by many who have no experience of the practical working of our Houses of Parliament, would like to see this new minister outside, and, if possible, above all the clash and jar of the coming in and the going out, and the necessity for conciliating particular phases of popular thought and opinion, and of steering clear of prejudice and of too sudden an interference with vested interests and old custom. He would like him to be independent, or to have a permanent advising seat in the Upper House, like one of our life peer law lords. In abstract theory this may seem workable enough, but in practice it could never fit into the lines of our present constitution. Public opinion very properly demands that every spending department should be represented in the Lower House, and should be directly responsible to the people, through their representatives, for the proper administration of the taxpayers' cash. The minister of health would be useless if he had not some command of money, and the nature of his duties would be such that it would be absolutely essential for him to have a seat in the House of Commons. How valuable his department will be in that assembly some years of experience enables me most fully to realize. How he will stimulate the languid interest now taken in these matters there, how the authority of his position will enable rapid progress to be made, and the definite nature of his duties will enable us to understand how to get information, and where to go for help, and guidance, and suggestion in time of need.

I do not for one moment pretend that with the appointment of this minister and his staff the sanitary millenium will be reached. Nor do I believe that his own official life will be, at all events in its early stages, an altogether happy one. He will find in the House of Commons, as well as outside, a strangely wide distrust of doctors and their aims and ways, a morbid suspicion bred by ignorance out of prejudice of their motives, and a desire to circumvent what they speak of as their tyranny

and their insatiable love of power; and then will come in other forces of obstruction in the shape of distorted views of personal liberty and freedom of action, and the individual right of practical dissent from the domestic ruling of the state, and the numerous fads and anti-movements, and fantastic dreamings of crocheteers, which never seem to fail to attract some kind of following. Much disappointment and grief will come to him out of these things, but he must have patience and soothe his vext soul as best he can, and then he will find the current turning in his favour at last. One difficulty will present itself, and this is at the bottom of Dr. Richardson's ideas—first to get a good man, and then to keep him. A curious parliamentary custom, I might almost call it a superstition, arranges the distribution of the great offices of state in such a way as to get the least amount of good out of the special qualities of the recipients. A man is an excellent home secretary, so when the next shuffle of the cards takes place, we find him installed in Pall Mall as war minister. A heaven-born "ruler of the Queen's Navee," when he has just found his sea legs, and got a notion of the motion of the ocean, is installed on a high stool, and told to add up sums as chancellor of the exchequer. But public health and its scientific management requires such prolonged and careful study, and its proper administration must be conducted with such special tact and care, that I hope an exception may here be made, and that on either side of the House carefully trained men may be found who will give themselves up to this work, and be put into office over and over again as opportunity offers.

But when all this possibly Utopian scheme is in full working order, when some diseases are abolished and others largely lessened, when we all live to a hundred years, and are full of life and vigour till near the end of our first century, where are we all to be stowed away? Can our tight little island be made elastic enough to hold its inhabitants? Can the swarming of our domestic hives into foreign lands go on for ever, or must some of our surplus population colonize our trees, as a magazine writer suggested some time ago? This is no concern of ours. Sufficient for the day is the good, as well as the evil, thereof. Make our people healthier and happier and longer lived, and those who come after us must find the means for employing them and stowing them all away; and as things generally right themselves for the best in the end, I have every confidence in committing this, like many other world problems, to the wisdom of the dim and distant future.

THE PROGRESS OF DEATH IN SCOTLAND AND HER COUNTIES SINCE 1855: A COMPARISON.

By PETER FYFE, Esq.,
Sanitary Inspector, Glasgow.

Since you did me the honour to elect me President of this Association, I have been somewhat anxiously meditating upon an address which might be instructive and at the same time run on paths comparatively untrodden.

In these days of general enlightenment and voluminous publication, the observant mind soon becomes impressed with the salient features of any applied science. The science of sanitation is not excepted from this rule. It is young in years, but in the heart of the nation it is growing mature and strong. Men and women in this kingdom are now coming to understand and believe that, "in order to the prevention of filth diseases, the prevention of filth is indispensable;" and not only so, but also to appreciate, to some extent, Sir John Simon's other truism, that "the exacter studies of modern times have further shown that, by various channels of indirect and clandestine influence, filth can operate more subtly and also far more widely and more distinctively than our forefathers conjectured."

Two hundred years ago some of the fashionable and aristocratic celebrities of London stepped into their palaces, round the thresholds of which heaps of cabbage stalks and rotten apples had accumulated, and Macaulay tells us that at that period St. James' Square was a receptacle for all the offal and cinders, for all the dead cats and dead dogs of Westminster. The corollary of this state of matters was a death-rate of 1 in every 23 persons per annum, or 43 per 1,000.

It is consequently obvious that such distant forefathers as

these had "conjectured" little regarding filth *versus* health. To-day we are in many aspects of public health far past the conjectural period. We have arrived after great labour in the haven of certainty, and throughout the land, in the minds of even the ignorant and formerly unsympathetic, is arising a partial revolt against preventable disease and its causes. To us is given the proud position of leaders in the revolt. To make effective a further onslaught on the known enemies of health and life, we must carry extended convictions to the great body of the public, and I am firmly persuaded the London *Times* was on the right lines in its editorial of 11th August on the Congress of Hygiene and Demography, lately held in London, when it said—"The most pressing work of sanitary reformers is not now so much to legislate as to educate."

In thus expressing myself, I do not wish it to be inferred that I am satisfied with our Public Health Act of Scotland.

Before I conclude, I think I will be able to show that death from one dreadful preventable malady practically remains unchecked in our land. I refer to tubercular disease. The graves filled by tuberculosis are year by year far too many, and it will be one of the foremost aims of my address to-day to show with certainty how we stand statistically as a country in relation to this scourge. I thought it would be new and instructive also to demonstrate the general progress of health in Scotland, and the particular decrease and increase of death in her thirty-three counties since registration in 1855 to 1888—first, from all causes; second, from zymotic disease; and third, from tubercular disease. I trust I am not in error in believing that the pictures of death thus delineated will serve a threefold purpose, namely—(1) To excite the interest and attention of our legislators and our central authorities; (2) to produce a healthy stimulus to sanitary activity in our county and burghal Local Authorities; and (3) to exhibit to the people at large in a simple, graphic, and incontestable manner, the past triumphs of sanitation over disease in some localities, and otherwise the triumphs of disease where and when probably few or no attempts have been made sanitarily to check its progress.

Before entering upon these demonstrations, it is due to explain to this Congress, as briefly as I can, the methods adopted and the basis upon which my thesis rests.

First of all, permit me to state my thesis. It is, that while Scotland as a country has advanced during the past 33 years in public health, and the death-rate from zymotic disease has all over been greatly reduced, tubercular disease has not made a corresponding advance, and in a considerable number of localities has in this period been stationary or increasing; and further, as tubercular disease is now known to be largely preventable, and has been proved to be communicable from man to man and from

animals to man, the time has come when it is desirable and necessary, in the interests of the people, to have such special legal powers from Government as shall, when applied, materially reduce the death-rate from this class of disease.

To prove the first of my premises I had recourse to the Scottish Registrar's yearly returns. From these 33 statistical haystacks we have the directing lines of mortality, which you see pointing upwards and downwards in the diagrams before you.* The single diagrams at the top represent in a striking and lucid way the successes of our "last enemy" among the people of Scotland and in each of our counties from year to year since 1855. The deaths represented here are from all causes in each 10,000 persons living. Immediately beneath this "all causes" diagram you will observe two interwoven diagrams—one drawn in full black line, the other in dotted line. These represent the number of deaths in Scotland and in each separate county which occurred yearly since 1855, (1) from zymotic disease and (2) from tubercular disease out of each 100 deaths from all causes.

The upper diagram, accordingly, exhibits the *general* progress or retrogression of the people in healthfulness; the lower ones, the progressive incidence upon the general death-rate of the two classes of disease which are most destructive, and which are more directly amenable to sanitary influences.

In connection with the lower diagrams, let me here explain what I have put down as zymotic, and what as tubercular disease. The Registrar-General of Scotland has twice changed the list of diseases called "zymotics" since 1855—viz., in 1877, when Dr. Farr's nomenclature was used for the first time; and in 1883, when the "classes" and "orders" of disease were enlarged and again rearranged. Six "orders" of disease appeared this year in the class "zymotic" instead of four; while to the "constitutional" class four sub-orders were added, two of them—viz., rheumatic fever and purpura being taken from the zymotic class. All this rearrangement was doubtless scientifically necessary, but is to the statistician, among such a plethora of figures, a source of perplexity and trouble. The prevailing custom in calculating death-rates from zymotic diseases is to take what are called the seven principal orders. These are—small-pox, measles, scarlet fever, typhus, diphtheria, enteric fever, and hooping-cough. To make these zymotic diagrams as comprehensive as possible, I have added to this list chicken-pox, relapsing fever, simple and ill-defined fever, simple cholera, diarrhœa, dysentery, erysipelas, and croup. The last mentioned disease is added for two reasons

* See diagrams accompanying this paper. In the diagrams showing Death-rates from All Causes per 10,000, the rates range from 100 at the bottom to 310 at the top. In the Zymotic and Tubercular diagrams, the percentages range from 0 to 40.

—first, and mainly, because up to 1877 it is hopelessly entangled with diphtheria in the Registrar-General's reports; and secondly, it has been thought by many experts to be the same disease as diphtheria, especially in its membranous form, and a predisposition to it appears to be caused by imperfectly drained dwellings, sewer emanations, and low lying sites.

Tubercular disease, the rates for which are shown by the dotted line diagrams, includes all deaths through phthisis, tabes mesenterica, tubercular meningitis, and scrofula. These four main so-called constitutional diseases are taken by the Registrar-General up to the latest date to represent the sum total of devastation wrought by the tubercular virus. The line of death representing the yearly incidence of this dreadful disease on the various populations in the counties of Scotland, high as it may appear in the diagrams, is, I am convinced, below the real level. This is not the fault of the Registrar-General or his various assistants throughout the country. It is well known that the word *consumption* is a terror in families, and the popular belief that it is in itself the legacy of heredity interferes with many medical men, and has a tendency to hinder them from telling under their certificates the whole truth. This is especially the case when ladies of marriageable age happen to be among the bereaved. Surely some method could be devised (and it certainly ought to be) whereby the medical attendant may be legally required to write upon his certificate the true cause of death, and hand it, or send it *direct*, to the local registrars without submitting it to the scrutiny of relatives. In the minds of true sanitarians and vital statisticians, any system which tends to bring influences to bear against a statement of the real facts stands condemned. If secrecy be necessary and expedient, by all means let us provide for secrecy, but not at the expense of truth.

Having said so much, let me now draw your attention to the diagrams and the table of septennial death-rates. It is far from my intention to weary you with any detailed review of these diagrams. Each of them will, I think, repay quiet and thoughtful study, and it is my hope that if they are placed before you in a reduced and compact form, you will not find it waste of time to bestow this upon them. The essential part for us at the present time is what they prove, and to a statement of this I address myself.

From the initiation of the Registration Act for Scotland in 1855 down to the year 1862, our country may be said to have existed, sanitarily speaking, in the most nebulous condition. Our legislators were just awaking about this time to the fact that the apparently deeply rooted philosophy, to the effect that each death was to a very small circle calamitous and distressing, but to the social fabric of the State was more or less advantageous as it

removed a consumer of the common stock, was a vast mistake. It was beginning to dawn upon them that every death under the non-productive age period was a total loss to the community at large. The cholera epidemic had in 1848-49 devastated Scotland and filled all classes with intense alarm, and the State Board of of Health were urging Scottish centres of population to bestir themselves to greater cleanliness. Yet it was not until 1862 that Scotland obtained anything approaching sanitary powers, and these were meagre at the best. Accordingly, I have taken the seven years wherein we had the benefits of registration previous to 1862—namely, 1855 to 1861, both inclusive—and exhibit upon a table—first, the average death-rate from all causes per annum per 10,000 inhabitants in Scotland, and each of her counties for these seven years ; second, the average percentage of these deaths attributable to the zymotic diseases I have already named ; third, the average percentage of these deaths attributable to tubercular disease.

These appear in three columns on the left hand side of the table, and together they may be termed the statistical sanitary picture of "Earliest Scotland," as previous to 1855 we can get no authentic vital statistics anent our country. It will be observed that the various counties are arranged according to the lowness of their respective death-rates from all causes. Against these figures are given upon the right hand identical equivalents for the last septennial—viz., 1882 to 1888. The red figures down the centre show the changes which have been made as between the various counties, in the order of their least mortality from all causes.

During the twenty-one years which elapse between these two septennial periods, it might reasonably be imagined that in every part of Scotland a steady advance in life-saving among the people had been going on, as for a long time previous to 1882 we had legal instruments at command wherewith to elevate the public health to a certain degree of excellence, if the various responsible burghal and parochial authorities had done their duty.

The table now before you holds up the mirror to the duty which has been done. The difference in Scotland between the all causes death rates of the first septennial and the same rate in the second is 14·43 per 10,000 of the population per annum. This means a saving of life during these last seven years to the extent of 5,561, every year calculating the population of Scotland as at the middle year—viz., 1885, or a total saving during the whole term of the septennial of 38,927 lives.

Gentlemen, this is a portion of the reward of sanitation, but a greater reward still is shown by the first diagram, as the heaviest incidence of death upon the inhabitants of our land is there shown to have been between the years of 1864 and 1875. Even a more direct evidence of the effect of sanitary work is shown by the general decrease of mortality from zymotic diseases. During the

course of the first septennial, 21·28 per cent of the total deaths were from zymotics.

In the last septennial the percentage fell to 13·16, or a decrease of 8·11 per cent. I regret I cannot give a similar account with respect to tubercular disease. Our progress against this dread enemy of life has been by comparison microscopical. 16·14 per cent of our total dead fell victims to this plague in the first septennial, and 14·48 per cent in our last, or a difference in favour of our last of only 1·66 per cent.

Having now glanced at our country as a whole, let me analyze a little, and show you where public health has improved, where it is stationary, and where matters have grown worse. Taking the death-rate from all causes first, the following counties show, in comparing the two septennial periods, an improvement of over 10 per 10,000 living—viz., Haddington, Nairn, Aberdeen, Perth, Stirling, Dumbarton, Ayr, Forfar, Edinburgh, Renfrew, and Lanark. Those that show an improvement under 10 per 10,000 are Peebles, Kincardine, Banff, Roxburgh, Fife, and Kirkcudbright. The counties which have remained stationary are Berwick, Ross and Cromarty, Sutherland, Wigton, Dumfries, and Bute.

It is now my duty to point out that ten counties have apparently gone back in health, six of them to an extent less than 10 per 10,000, and four of them over 10 per 10,000. The former lot of these "black sheep" comprise Linlithgow, Clackmannan, Kinross, Argyle, Elgin, and Orkney; the latter, Selkirk, Inverness, Caithness, and Shetland.

In fatalities from zymotic disease, the table and also the diagrams show a universal progression in the right direction. No county bears the terrible stigma of being reactionary with regard to truly infectious maladies. While this is so, it will be observed that a few counties have been lingering on the way. I take an example. It is the pigmy county of Scotland—little Clackmannan. From 1855 to 1861 her average zymotic rate was 16·71 per cent of her total deaths. In the 1882-88 septennial it was 13·78, or 2·93 per cent of an improvement in twenty-one years. Her little twin-sister, Kinross, in the same period made an advance of 8·97 per cent, or over three times greater progress. The county which has the highest credit, from the table and diagrams illustrative of the progress of zymotic disease, is Forfarshire. No less a difference than 12·70, or nearly 12¾ per cent, is shown in the last seven years over the first seven. A very high zymotic rate was maintained in this county until 1874, after which, as if by magic, these diseases fell from their deadly eminence of 28 per cent to 16 per cent in 1875, and they have rarely done much more mischief up to 1888. Forfarshire is to be congratulated on her success in grappling with zymotics, as although she is handicapped with the third city in Scotland—

"Bonnie Dundee"—and although she is only thirtieth in general healthiness, in freedom from a high zymotic rate she ranks twenty-third.

The county which in the 1882-88 septennial shows absolutely the lowest average zymotic rate is Orkney at 5·74 per cent. The lowest rate during the 1855-62 septennial was 9·57 in Sutherlandshire, so we see that progress in this direction has been made even in minimums.

Speaking generally, in similarly conditioned communities a universally low rate of mortality from infectious disease indicates a high rate of health administration. Sanitary zeal means shrinking zymotics. Liberal expenditure for health purposes by any sanitary authority may be taken as indicative of sanitary zeal. In making these statements I have my eye at present on one of our most beautiful pastoral counties, through which the Ettrick and Yarrow flow in pellucid sweetness. Selkirkshire, rich in beauty and historic associations, is, alas! also rich in zymotic death. Her position is so strange in this respect, compared with her surrounding neighbours, that I was tempted to enquire into the cause.

You will observe from the table that, while Roxburgh and Peebles have an average zymotic rate of 10·84 and 9·54, Selkirk, although eighth among the counties in her general rate, permits 13·13 per cent of her dead to succumb to this class of diseases. If she were arranged according to her zymotic rate she would fall from being the eighth in position to the twenty-sixth.

Now I find from Dr Skelton's *Handbook on Public Health and the Local Goverment Act*, page 54, that Selkirk, as a county under the Public Health Act, 1867, administered by the Parochial Boards, had the following staff to carry on sanitary administration :—Medical officers, none; sanitary inspectors, 5; total amount of salaries paid to these five sanitary inspectors, £16, 10s. per annum, or at the rate of £3, 6s. each. I find also from the annual reports of the Board of Supervision from 1882 to 1888, that the total expenditure for public health purposes in all Selkirkshire during these years was £1,974. I have mentioned the zymotic rates of Roxburgh and Peebles in comparison with that of Selkirk. Let us see how they compare as to the means employed and the money expended in the cause of public health. Roxburgh, having fully double the population of Selkirk, employed in the county 9 medical officers at an expenditure of £28, 14s. per annum, and 24 sanitary inspectors at an expenditure of £95, 19s. per annum; while, in the course of the seven years 1882 to 1888, she spent no less than £44,824 in the cause of public health. Peebles, with a population almost the half of that of Selkirk, had for county purposes, 2 medical officers costing £4, 16s. per annum, and 10 sanitary inspectors at an outlay of £35, 10s. per annum; and in the seven years for public health

purposes she spent £7,981, or, with half the population, £6,007 more than her populous sister. Other, and to me unknown, eauses may be at work to plaee Selkirk in her unenviable position; but it is quite evident that what her people have gained in poeket they have more than lost in zymotic filled graves.

Other counties, such as Linlithgow, Renfrew, and Lanark, exhibit features in this respect of melancholy interest, and it behoves the burghal and county authorities within them to purge their distriets of diseases, whieh have no right there in the proportions in whieh our table and diagrams find them. This remark may be said to apply with greater force to Linlithgowshire than to the other two, in that the latter have within their borders the busy eentres of compacted population, where the zymotic baeteria ean slay their vietims in the greatest numbers. That we should find Linlithgow, over the last seven years, permitting infectious disease to prevail to such an extent as to plaee her third from the worst in Scotland, is, to say the least of it, unexpeeted ; but, while it casts unavoidable refleetions on her past authorities, it should form a strong incentive to her new authorities to spare neither money nor pains to regain for her her true position among Scottish counties. I would fain linger upon these zymotie diagrams, and show how they influence the "all eauses" diagram above them, how the sharp peaks of the one are often faithfully reproduced year after year upon the other; but I must pass on, contenting myself with calling the students' attention, espeeially those of Scotland, to Caithness, Elgin, Aberdeen, Forfar, Perth, Clackmannan, Dumbarton, Renfrew, Edinburgh, Peebles, and Dumfries.

We now come to eonsider the thirty-three districts of our eountry in relation to tubercle in its fourfold forms. The first thing we see in looking at the dotted line diagrams is the even lines of death-rate which they show for the most part. In scrutinizing closely, however, we find that a gradual, though very small improvement has taken place in twenty-two eounties. These are Orkney, Caithness, Sutherland, Inverness, Ross and Cromarty, Kincardine, Elgin, Banff, Nairn, Argyll, Kinross, Perth, Aberdeen, Ayr, Bute, Dumbarton, Edinburgh, Renfrew, Lanark, Berwiek, Roxburgh, and Wigtown. In six counties the tuberele bacillus has apparently held his own—namely, in Claekmannan, Haddington, Linlithgow, Stirling, Forfar, and Dumfries ; while in the remaining five this insidious foe has actually gained ground sinee the early years of the fifties. These five are Shetland, Fife, Selkirk, Peebles, and Kirkeudbright. As might naturally be expected from its situation, its dry and bracing elimate, and its free loamy soil over a gravelly or sandy substratum, Nairn bears the palm along with Inverness among the eounties for freedom from tuberele. During the first septennial, 13·71 per eent of the total dead in Nairn fell from tuberculosis.

In the last septennial this percentage fell to 9·51, or a difference of 4·2 per cent. For the same periods Inverness shows 11·42 and 9·47 respectively, or a fall in the last septennial of 1·95 per cent. These are the only counties which can boast of a single figure percentage in this column. Aberdeen and Bute are the only other counties which show a reduction of over 4 per cent in this rate in the 21 years.

It is with sorrow that I find our beautiful Selkirk again showing herself sanitarily ugly. She ranges in tubercular death far ahead of any other county, no less than 18·36 per cent being her average rate during the last septennial from tubercular disease. This rate of death is 2·36 *more* than she was burdened with from 1855 to 1861. Her position both in respect of zymotic and tubercular disease and death demands, in my opinion, enquiry on the part of our central authorities into her condition, and as to the causes which are at the root of such an unfortunate state of affairs.

Now, Gentlemen, what conclusion can we come to as we glance along those almost parallel dotted lines? Is it not this, that since registration began in 1855 down to the year 1888, so far as tubercular disease is concerned, sanitation, as at present supported by law, has been, comparatively speaking, a failure. The general health has improved, but proportionally tuberculosis has not been grappled with. In some counties we certainly can show that among a hundred graves, two or three less were filled by consumptives during the last than during the first septennial, but for all Scotland the national graveyard contains in the last septennial only 166 tubercular victims less per 10,000 of the departed than it did in the first. We are not satisfied to call this progress, and less so than ever since Koch in 1881 discovered and demonstrated the immediate cause of tuberculosis.

The second premise of my thesis—viz.: "that tuberculosis is communicable from man to man and from the lower animals to man," is not, unfortunately, capable of such complete demonstration as the first. We cannot, unhappily, draw a diagram which would show conclusively that that number of men or women fell victims to the dread bacillus from breathing contaminated dust, or eating infected food, or drinking inoculated milk, nor (2) are our scientific experts agreed among themselves upon certain points connected with the inception of this baleful disease, but now we do know that a specific bacillus does exist as the direct cause of tubercle, and most of us believe that dwelling under certain conditions, and eating and drinking food containing the spores or seeds of the tubercular germ will, in all probability, end in the consumptive's doom.

What do we mean when we say that our people are made phthisical by "dwelling under certain conditions?" We mean that this contagion, like that of several of the zymotics, is pro-

pagated, if not caused, by filth in the wrong place:—Filth in the home and its surroundings, filth on the person, filth in the air breathed, filth in the food and drink. By filth, we mean all matter, both general and specific, which tends to cause or breed disease.

Gentlemen, it sometimes appears to me cruel on the inhabitants of our land that tubercular disease, which yearly cuts off one-seventh of our dead, should be one of slow progress. If, upon its first entry into the human system, it were as keen and deadly in its course as small-pox or typhus fever, we would long ere this have been compelled to face boldly and resolutely the problem of its amelioration, if not of its extinction. But, alas! its progress is so insiduous and tardy that long before it becomes in the individual diagnoseable, or ends in his demise, we have lost all trace of the circumstances attending its causation. To us who cry aloud for free and abounding ventilation of workshops, factories, schools, and dwellings, it is galling to hear the sneering reply of the unbeliever—"Where is your proof that vitiated air is the direct cause of phthisis?" We seek to enforce the thorough subsoil drainage of an inhabited locality, believing strongly in Dr. Buchanan's evidence that this appears essential to the diminution of phthisis. Again, the infidels confront us with the words, "Theoretical nonsense." The poor unfortunates, within whose withering frames the fierce malady is burning, unlike the victims of enteric, typhus, or scarlet fever, can move freely about in society, scattering broadcast on floors, beds, in our public places—nay, around our very children, the deadly sputum which has been proved to have been full of infectivity; here, again, we are helpless, and legislation is dumb. The flesh of the tuberculous ox, and the milk of consumptive cows are still surreptitiously vended among the people at imminent risk to health, and only a few populous centres are armed with powers specific enough to grapple with the danger.

Gentlemen, we are still "conjecturing" as to whether these things are "channels of indirect and clandestine influence," through which in one decade a fortieth of our race arrive at "that bourne from which no traveller returns." I am afraid it is the case that in this matter we are yet wondering what to do. As an engineer, I do not hold myself as competent to judge upon this momentous question, but along with many other laymen, who are reading from time to time the widely diverging views of scientists and experimentalists, I feel that, if what some of the best of them say is true, the population under our care have grave reason for demanding instant remedial legislation. It was with eager expectancy that I read the London *Times*' report of Professor Burdon Sanderson's address in opening the discussion on "Tuberculosis." When I got to the end of this discussion I was still in a state of expectancy, for although the Professor came to the

conclusion, as an individual, that "the creation of a systematized meat inspection, extending not only to the great towns, but over the whole country, was desirable, and that tuberculosis should be included in the schedule of the Contagious Diseases (Animals) Act"; and although other eminent investigators admitted the risk to the public of giving them the milk and the flesh of animals affected with tubercle, I found that the motion, which was gravely put and carried as the result of all this important discussion, was in these terms—"That the etiology of tubercular disease of early infancy, between three months and five years old, be *referred for discussion at the next Congress.*"

Gentlemen, this may mean much or it may mean little, but to the ordinary intellect, applying itself as best it may to the whole bent and meaning of this debate of the savants, it is certainly "caution large," if, indeed, it is not a discreet shirking of the whole matter.

Fortunately, as I believe, our Standing Committee on Sanitary Matters in the House of Commons, of which our President of Congress, Dr. Farquharson, is a distinguished member, have the courage of their opinions, and have passed measures lately for Glasgow and Edinburgh, which enables these cities to guard their citizens in great degree from the consumption of beef and milk inoculated with the specific virus of tubercle.

Last year, before the Congress of this Association in Perth, Professor Hay attacked, in a lucid and most valuable paper, the impure air of many of our schools, and showed clearly how many of our children are in all likelihood done to death in close and ill-ventilated class-rooms. Your President of last year, Dr. Cameron, M.P., referred at the end of his able address to the smoke-laden condition of the atmosphere of our towns as the prime factor in lung disease; and again and again the fœtid air in the houses of the poor has been proved to be the destroyer of youthful life, and the cause of ultimate death in those who have passed into maturer years. But as yet we have no specific law as to the quality of a town's atmosphere, and a very imperfect law as to the production of smoke. We have no law as to the quality of air which must be supplied to our school children, nor have we any power to compel adequate ventilation in humble dwellings, which may not be stopped by the injudicious application of a bundle of rags by the ignorant householder.

Subsoil drainage in a damp and low lying town or village site is in no way compulsory, and consumptive nurses may still, without let or hindrance, tend our young children, and spread around them unconsciously one of the many mantles of the destroying angel. The law is silent on those vital concerns. Who is to blame? Who, but the people themselves. They want teaching, they need warning, they require working up.

Gentlemen, this is your duty. Upon you, as the sanitarians of

Scotland, aided by the public press, lies, first of all, the responsibility. When that responsibility is faithfully discharged, and the people of our country awake to a full knowledge of the "indirect and clandestine influences of filth" in its hydra-headed forms, we may rest assured our Government will, in the future as in the past, reach forth to us the helping hand.

Note.—The author desires the kind assistance of all medical officers, sanitary inspectors, and other gentlemen interested in the progress of public health in Scotland, in clearing the tables and diagrams accompanying this paper from errors which he feels must have crept in. Any assistance in this direction will be thankfully received by the author, and will be publicly acknowledged by him in the *Sanitary Journal.*

TUBERCULOSIS VIEWED AS AN INFECTIOUS DISEASE: ITS PREVALENCE AND THE FREQUENCY OF RECOVERY FROM IT.

By JOSEPH COATS, M.D.

The subject of tuberculosis has of late years and months been under discussion from many points of view, and we have seen within this twelvemonth an extraordinary excitement in the public mind over the prospect of a cure for this form of disease. It is a subject worthy of discussion, one of the most momentous that can occupy the attention of those who are concerned with the study of disease in its various aspects. To-day I propose to call attention to certain points which ought to have some interest for sanitary officers if not for a wider circle, and I hope that my remarks will be freely discussed. To you who are steadfastly engaged in trying to diminish the frequency of disease and to mitigate its effects on the health of the community at large, it may be of consequence to have your memories refreshed as to the prevalence of this the most frequent of all the forms of disease that human flesh is heir to. A consideration of its very great frequency will lead us to look for the sources of the disease, and to make suggestions as to prevention, a matter in which you are specially interested.

Let me, at the outset, state that, pathologically, tuberculosis is to be regarded as an infectious disease. The name tuberculosis is now strictly limited to those forms of disease in which the bacillus of Koch plays an essential part. It was in the year 1882 that Koch announced the discovery of the tubercular bacillus, only nine years ago, a mere moment in the history of mankind. How that discovery has changed the views with which we regard this group of diseases! Koch's bacillus is a microbe consisting of minute threads. It can be grown outside the body

on suitable nutrient media, but both inside and outside the body its growth is exceptionally slow. In its growth this microbe produces an extraordinarily virulent substance. It was inferred from the processes visible in a tuberculous lesion that a violent poison was produced by the microbe, but Koch's recent observations have rendered this perfectly demonstrable, and give us also the opportunity of estimating the activity of the agent. The fluid introduced by Koch for the treatment of tuberculosis, and which is now commonly called tuberculin, contains the poisonous matters produced by the microbe when cultivated outside the body. I had a patient in the Western Infirmary to whom for purposes of diagnosis I administered the smallest dose of tuberculin, a milligramme. It promptly raised his temperature to 103°, and produced considerable local disturbance. This very striking effect was produced by an extraordinarily minute dose of the agent concerned. Let me put the quantities in our more familiar forms of grain and drop. Koch states that his fluid contains about 1 per cent of the essential principal, 1 grain in 100 drops. The dose administered was the thousandth of a gramme. A gramme is about $15\frac{1}{2}$ grains, and so a milligramme is about $\frac{1}{65}$ of a grain. This was the dose of the fluid, but as the fluid only contains 1 per cent of the essential principle the actual dose was only $\frac{1}{6500}$ of a grain, and yet this minute quantity was sufficient to produce a high fever and considerable swelling in the diseased parts. Surely this is one of the most virulent of known substances.

When the microbe finds access to the human body, if it gets a lodgment there, it produces its effects by means of the poison evolved. These effects I do not need to specify here further than to say that they usually imply serious disturbances in the tissues, partly of an inflammatory character, along with local death of portions of the affected structures. This local death often leads to extensive destruction of parts of the body, more especially the lungs.

While these are, briefly, the effects of the action of the microbe, it is to be noted that very striking differences exist in regard to the intensity of its action and the rapidity with which the disease advances. It may indeed be said that there are all degrees of difference in the reaction which different persons show to the action of the tubercular poison. There is no reason to doubt that, on the one hand, many persons receive the bacillus into their bodies without showing the slightest indication of its presence. The vigour of their tissues is sufficient to prevent the infection getting hold, and the microbe simply dies out. On the other hand, there are some who are so susceptible that, once introduced, the disease makes rapid advance, and progresses with vigorous strides ever onwards. Between these two extremes there is every gradation.

Leaving these preliminary matters, my object now is to try and form some estimate of the frequency of tuberculosis in its various forms. Taking all the children born in the United Kingdom, how many are fated before life ends to become affected with this disease? It is no easy task to answer this question. The Registrar-General's tables of mortality will not give us sufficient information, because, not considering for the moment other sources of error, they give us only the number of persons who have *died* of tubercular disease, and not of those who either recover or remain more or less permanently injured by it. But there is a further important source of error in the Registrar-General's returns. There are the errors in diagnosis. This source of error applies especially to children, and that for several reasons. For one thing, there is a much larger number of uncertified deaths in the case of children than of adults, and such deaths are most likely to be certified incorrectly. But besides this, tuberculosis frequently ensues in children in the course of an imperfect recovery from other diseases, especially measles, hooping-cough, and bronchitis; and the death is frequently certified as due to the primary disease, which, however, is not really the fatal one.

Taking up first this last source of error, it may be possible to correct to some extent the errors in the registration returns, by looking to the results furnished by institutions devoted to the care of children where a skilled investigation of the diseases is made, such institutions as Children's Hospitals, &c.

In the volume containing the transactions of the Congress for the study of tuberculosis, held in Paris in the year 1888 (p. 202), I find that Landouzy has a paper on tuberculosis in the first years of infancy. In regard to this matter he says—"Our statement regarding the frequency of tuberculosis in the newly-born is based on the observations made by us at the Crèche of the Hospital Tenon, where fifty *post-mortems* of pronounced tuberculosis, occurring in about five years, have shown that, in this special sphere of observation, of every three children aged from a few weeks to two years in whom a *post-mortem* was made, on an average one was tuberculous.

"What occurs at Tenon seems to be identical with that which is found in other analogous hospitals. This is, at least, the opinion of our masters, Professors Hayem and Damaschino, whose opinion is based on the facts observed at Saint-Antoine and at the Hospital Laënnec."

These are the results obtained from observations in Paris—a third of the infantile mortality is from tuberculosis.

I have taken the trouble to look up some reports of children's hospitals in this country in order to check these observations. I will give you some of the results taken at random from the annual reports of well known hospitals.

The Great Ormond Street Hospital for Sick Children, in the report for 1877, shows 76 deaths from all causes, and 27 from the various forms of tuberculosis—a percentage of 35·5, or over a third.

In the report of the General Hospital for Sick Children, Manchester, for 1881, the total deaths are 89, and the deaths from tuberculosis 24, a percentage of 27, or nearly a third. In the same Hospital the report for 1885 gives 88 deaths and 36 from tuberculosis, a percentage of 40·5, or somewhat over a third. In our own Hospital for Sick Children in Glasgow, I find that the figures are similar. In the report of 1889, the total deaths are 53, and 24 are tubercular, or 45 per cent. In that for 1890 the deaths are 49, and of these 17 are tubercular, or 34·7 per cent.

Taking all these mutually confirmatory results into account we may, I think, safely affirm that of the total deaths under 10 years of age, amongst the mass of the people, about a third are due to tuberculosis. Bearing this in mind let us see what the Registrar-General's returns show us. I take the last published Detailed Annual Report for Scotland, that for 1888, and I find that the deaths registered as from tuberculosis under 10 years of age form only 10·6 per cent of the whole deaths under that age, or about a ninth instead of a third. The deaths under ten form indeed a lower percentage than those above ten, the latter giving 15·5 per cent of deaths from tuberculosis. If we infer, however, that a third of the deaths under 10 were really from tuberculosis, then the deaths from tuberculosis at once mount up from a total of 9,725 for the year 1888 to 15,631 for that year, and this raises the total percentage from tubercular disease from 13·6 to nearly 22 per cent.

I trust you have been able fully to follow these calculations. They do not pretend to be an exact statistical statement, but they serve as an indication of the points I want to bring out. Let me repeat. The observations in institutions where the diseases of children are carefully observed, show that tuberculosis is the cause of death in about a third of the whole deaths. But according to the returns for Scotland for the year 1888, tuberculosis was the cause of death only in 10·6 per cent of the whole deaths under 10. This can only be accounted for by errors in diagnosis, or by deaths being ascribed to the remote cause and not to the real one. If we rectify this error then we bring up the general death-rate from tuberculosis to about 22 per cent of the whole deaths.

It may be interesting to observe here that this rate of 22 almost exactly corresponds with what I have found from my own observations at the Western Infirmary. I shall allude to these observations further on, but I may here say that in 131 *post-mortem* examinations I ascribe tuberculosis as the cause of

death in 28, giving a percentage of 21·37. It is to be added, however, that as comparatively few children are treated in the Western Infirmary, this percentage is to be taken as for adults, and serves as an indication that even the percentage of 15·5 which we obtain from the Registrar-General's report is not high enough.

Having arrived at the conclusion that about 22 per cent of the deaths in this country are due to tuberculosis, we have next to consider what may be its frequency amongst those who are not stricken to death by it. It is to be remembered that there is a great deal of tuberculosis, in children especially, which is amenable to surgical interference. There are the scrofulous glands, chiefly in the neck, so often seen in children, and rarely fatal, and there are tubercular diseases of bone, many of which may be cured by the timely removal of the affected parts, and there may be recovery with very little remaining traces of the disease. There are also tubercular diseases of the skin, the most frequent of which, lupus, is very common. The frequency of cases of this sort can scarcely be estimated. They must be numerous.

Besides them, however, it is of great interest to find that recovery frequently occurs from internal tuberculosis. On *post-mortem* examination it is quite common to find evidences of healed tuberculosis. Such evidences are most frequent in the lungs, where, as you know, tuberculosis has its most deadly seat.

A comparative estimate of the frequency of healed tuberculosis may be formed by a careful scrutiny of *post-mortem* records. Such a scrutiny was made by Dr. Thos. Harris, of Manchester, in an admirable paper published in the *British Medical Journal* for 1889 (vol. ii, p. 1,385). I need not go particularly into his results, but he came to the conclusion that taking the deaths of persons over 20 years of age, what he calls involuted tuberculosis of the lungs was present in about 38 per cent of the cases. I feel inclined to regard this percentage as rather high on the ground chiefly that Dr. Harris includes a few cases of active phthisis in which there was partial healing, and also that microscopic examination showed in some cases that the disease was not quite latent.

My own observations do not completely bear out Dr. Harris's, but they show the existence of a remarkable number of cases of healed tuberculosis. I have taken the *post-mortem* examinations in the Western Infirmary for about ten months from the end of October 1890 till the end of August 1891. These examinations were almost all made by myself. Excluding partial examinations, and a number of cases made in my absence in which special attention was not directed to the lungs, I find a total of cases available of 131. Of these, 28 showed signs of active tuberculosis,

and tuberculosis was assignable as the cause of death. Excluding these we have 103 cases in which death was the result of some disease other than tuberculosis. In these 103 cases I found 24 which presented distinct evidences of healed internal tuberculosis, and, of these, 20 showed healed tuberculosis of the lungs. That is to say, about 23·3 per cent of the cases dying from such diseases as cancer, heart disease, apoplexy, &c., showed that in a former period of life they had been affected with tuberculosis. I may add that in all these cases the tuberculosis was entirely healed, and not at all active. I may say also that they were mostly cases of persons well on in life, 17 out of the 24 being over 40 years of age. These persons when they were young people had been affected with some form of tuberculosis, chiefly consumption of the lungs, and had recovered completely from it. They recovered so completely that they lived on into middle or advanced life and died of diseases apparently unconnected with their former illnesses.

If now we add together the figures we have obtained from these various sources, we may form some estimate of the frequency of tuberculosis. We saw that, taking into account the frequency in children, tuberculosis furnishes, not about 15 per cent, but really about 22 per cent of the total deaths. We saw also that of those who die from other diseases a large number, variously estimated at 23 per cent to 38 per cent, show evidences of having been affected with tuberculosis of internal organs. Taking even the smaller figure, which does not include cases of external tuberculosis, and adding it to our first figure, we get a total of 45 per cent. That is to say, of all persons who are born into the world about a half, if not more than a half, are fated before they die to be affected with tuberculosis, in one form or other. This is, I take it, a sober fact, and one having sufficiently serious bearings on the health of the community.

How are we to account for this extraordinary frequency of tuberculosis in our midst? What is the source of it all? There can be no tuberculosis without the tubercular bacillus, and to get at the cause of this frequency we must consider the sources of the infection by the bacillus.

Let me here briefly relate two observations which came before me during the year. I was asked to make a *post-mortem* examination on the child of a professional friend. The child was 14 months old, and had been carefully tended during the short period of its life. I found that deep in the neck there was a tuberculosis of the glands, and that from this focus the infection had extended and had resulted in what is technically called an acute general tuberculosis. The other observation was that of an infant 7 months old, who died after a very short illness from what turned out to be the effects of a tuberculosis originally located in the glands near the root of the lungs. This child had

been partially fed with artificial food from birth, and had been weaned two months before death. These two cases occurring in families where the stock was a healthy one and the parents were able and willing to do the best for their children, struck me very much. The children had lived from birth under circumstances which externally were thoroughly sanitary. How had the infection reached them?

I will here relate a third experience during the year. I was staying for a few days in a country village near Glasgow last Christmas time. I went in the morning to a grocer's shop to procure the daily paper. One morning while waiting the arrival of the newspapers my eye caught sight of the lights and liver of two animals hung near the door to attract the attention of customers. Looking with the eye of a pathologist I at once saw that the liver of one was studded with tubercular nodules. The shopkeeper seeing me looking at the organs came forward in expectation of a customer to praise his wares as first rate pig's organs, to be had at a shilling a piece.

To account for the extraordinary frequency of tuberculosis in man we are to notice that the bacillus is to be found, not alone in one relation but in many. It may be taken for granted that wherever there is a tuberculous person, especially a person with tuberculosis of the lungs, there is an important source of infection. The sputum of consumptive persons contains the tubercular bacillus, often in vast numbers. The bacilli from this source are likely to contaminate the air especially, as the sputum on drying is dispersed as dust and the bacilli are carried as dust in the air. Besides this, however, the food is liable to be contaminated, especially in small unsanitary houses. But this is not the only source of tuberculosis. It is a very frequent form of disease in the domestic animals, especially in those consumed as food, more particularly in cattle. I do not think that it is sufficiently remembered that this great frequency amongst cattle implies the existence of a great deal of what may be called floating infection. The disease in cattle as in men is due to the presence of the bacillus, and it must be communicated by similar means. In animals the lungs are not so frequently the primary seat of disease as in man, and we may perhaps infer that the infection is less commonly communicated by the inspired air.

A question occurs here which has given rise to some discussion, and which is of consequence in several relations. By what paths does the infection reach the human body? In adults the lungs are the primary seat in a considerable majority of cases, and we may infer that in them the inspired air is the principal source of infection. I do not know, however, that this inference is by any means of anything like universal application. I know, for instance, from my own observations that when, in acute general tuberculosis, the bacilli are present in the blood, they are specially

liable to lodge and multiply in the lungs.* I notice also that Burdon Sanderson has recently recalled to notice an observation of his, that when the tubercular virus is injected into guinea-pigs subcutaneously, the occurrence of nodules in the lungs was one of the most constant phenomena.† In the case of adults, therefore, although we may admit that the infection is most frequently by the air, yet other possible modes can scarcely be excluded.

It is very different in children. In them the primary seat of tuberculosis is comparatively seldom the lungs, but more frequently the lymphatic glands and the bones. The position of the lymphatic glands most commonly affected in children is an indication that the infection is usually conveyed by the alimentary canal. We are all familiar with the so-called scrofulous, but really tubercular disease of the glands of the neck. When these glands are affected the bacillus has mostly obtained access by the mouth and its accessory cavities. Perhaps of equal frequency, although much less accessible for purposes of diagnosis, is tuberculosis of the lymphatic glands of the mesentery which are in relation to the intestine. When they are affected the virus must have reached them from the alimentary canal. In a recent communication by Professor M'Fadyean and Dr. Woodhead,‡ reference is made to this subject; they found that in 127 cases of tuberculosis in children, tuberculosis of these mesenteric glands existed in 100 cases or in 79 per cent of the whole. It may be added that the bacilli may be carried to these glands without any tuberculosis of the surfaces to which they are related. The lymphatic system of glands is connected with the lymphatic or absorbent system of vessels. These vessels are present in the mucous membranes lining the alimentary canal, and they pass from these surfaces to the glands. The vessels may absorb the bacilli and convey them to the glands without the bacilli producing any obvious effect on the mucous membrane. It is quite possible that a slight abrasion or wound may be necessary to admit the bacilli, but a proper tuberculosis is not requisite and, in the case of the mouth at least, it is very rare.

Next to the lymphatic glands, the bones are most frequently affected in children. In order to reach the bones the infection must travel by the blood, and it must be admitted to the blood by one or other of the avenues of the body. It may be sometimes by the skin, sometimes by the alimentary canal, sometimes by the lungs; probably it is most frequently by the alimentary canal, the bacilli passing by the lymphatics to the glands and thence onwards to the blood, this being the regular course of the lymphatic circulation.

* See on this subject, Gairdner and Coats, *Lectures to Practitioners*, 1889, p. 183.

† *British Med. Journ.*, 1891, ii, 404.

‡ *British Med. Journ.*, 1891, ii, 412.

From the facts before us we are justified in the inference that the tubercular infection reaches the human body mainly by two paths, by the lungs and by the alimentary canal. In the adult it is mainly by the former, and in the child by the latter, although in neither is one of the paths the exclusive one.

And, now, what are the inferences to be derived as to the measures necessary to prevent the access of the tubercular infection? We have seen what are the two chief sources of the infection, namely, tuberculous men and tuberculous animals, and we have seen what are the two principal paths by which it finds entrance. As practical people it should be our aim to check the supply at its sources, and use precautions against its entrance. I wish every member of the community was impressed with these two facts—namely, that about every second human being born becomes infected with this deadly disease, and that the source of this infection is demonstrably in the men and animals already affected. What would be the result if such a conviction were impressed on the general community? Take first the human source of infection. Would it not be the plainest dictate of common sense to exercise the most careful precautions in regard to the expectorations and discharges from a tuberculous person? Not only so, but where such persons were present the freest possible dilution of the atmosphere with fresh air would be carefully seen to.

Is it still too soon for us to expect that the community will, in its public capacity, regard tuberculosis as an infectious disease—to be treated, in some measure at least, on similar principles to typhus, scarlet fever, and measles? Is it not curious that such a question has scarcely been discussed in this country? And yet, if there is any truth in what I have been saying, there is in regard to this disease as great a degree of preventibility as in the case of the acute fevers. I feel that, in view of the extraordinary prevalence of this disease, the questions of notification, isolation, and disinfection ought to be seriously discussed. I have referred elsewhere to the close analogies that exist, pathologically, between leprosy and tuberculosis. The microbes in the two forms of disease are remarkably similar, both being in the form of bacilli. Both are of very slow growth, and in both cases it is most difficult to prove the direct communication from person to person. But, in olden times, all over the civilized world it was recognized that the leper was a danger to the community. They had no knowledge of the existence of microbes, but they must have become convinced that the leper was, perhaps only indirectly, a source of infection; and so, by methods which in our own times would be properly regarded as unjust, if not inhuman, he was separated from his kind. I cannot but believe that these measures have had a great deal to do with the disappearance of leprosy from the greater part of Europe, although I by no means deny that other

elements, such as the general improvement in the mode of life of the people, have borne a part. In regard to tuberculosis, I shall have to refer further on to the treatment of this disease with a view to its cure in the individual cases; and I am convinced that, with a view both to treatment and prevention, such a degree of isolation as is implied in separate country homes and hospitals would be of great advantage both to the patients and to the community.

In regard to the other source of infection—that from animals—it has been abundantly demonstrated that infection may occur by means of milk from tuberculous cows. This has naturally suggested a careful oversight of the milk supply. But, if the public were sufficiently impressed with the gravity of the situation, surely a broader position would be taken up. The existence of tuberculosis in animals implies a great deal of floating infection, which is a constant danger to the community. The remedy, so far as the animals themselves are concerned, is similar to that in the case of man—a rigid system of isolation, cleansing, and disinfection. Is it too much to ask that everything known to be contaminated with the tubercular infection should be destroyed where possible?

The existence of a tuberculous animal, whether living or dead, is not only a risk to the community, but is in itself evidence that the arrangements for cleansing and disinfection have been incomplete. On both grounds I think the animal should be destroyed as a danger to the community. It is only by such means that the reality of the danger can be brought home to those concerned, and that sufficient precautions will be taken against it. I firmly believe in the immediate risk from tuberculous cattle to those who consume the milk and meat; but I think it of equal, if not of greater, importance, to recognize that these indicate a source of infection which is perfectly remediable, and ought to be removed.* The way to get at this source of infection is to condemn everything which is known to be contaminated with it. In this view of it I do not understand the attempt to discriminate between parts of a tuberculous carcase, some being infected and some not. If the body is infected, that should be enough. Suppose it were known that leprosy existed in animals, and that the disease was confined to the skin, is there anyone who would say—Let the carcases go, after the skin is removed? Would it not be said justly—the only way to stay the infection is to condemn all animals which show it? If a single leprous man in London recently created such a panic, what are we to say to the fact that a vastly more deadly infection is present in our midst, and people seriously discuss whether the carcases of the affected animals are to be spared or not?

There is still a branch of my subject which I have just touched on, but have not fully elaborated—I refer to the recovery from

or healing of tuberculosis. From the statistics which I have already adduced it appears that, taking even the most serious forms of internal tuberculosis, such as consumption of the lungs, tubercular disease of the vertebræ, tuberculosis of the peritoneum, there is evidence that spontaneous recovery takes place in a proportion nearly equal to that in which death results. To this we have to add the recoveries from tuberculosis of the skin, as lupus and other forms, tuberculosis of the bones of the limbs and of the lymphatic glands, from which recovery occurs, in a large majority of cases, with or without surgical interference. I think it will be useful to consider, from a practical point of view, the mode of recovery and the conditions which favour it.

The tubercular bacillus in its action nearly always produces a local death or necrosis of the tissue on which it acts. There is, therefore, usually a focus or central piece of dead tissue, surrounded by altered living tissue in which the bacilli are actively continuing their work. Both the dead and living tissues contain bacilli which are alive and capable of further malignant action. In the treatment of a scrofulous lymphatic gland the surgeon endeavours to get rid of all the infected structures whether dead or living. He lays open the part and scrapes away with a small spoon-shaped instrument all the accessible parts. It is the same with a tuberculous joint. The joint is laid open, the infected lining is removed, and if necessary the infected ends of the bones are sawn off.

It is clear that this line of treatment is not available for important internal organs such as the lungs, but nature has her own way of dealing with the disease. For the most part, as the disease proceeds in the lungs the dead parts are separated and expectorated, so that a consumptive person literally spits up his lungs. It is a true consumption of the lungs, which goes on almost continuously in advancing cases. If the dead part is small or out of reach of the air passages by which it might find exit, then it may be retained for long periods and undergo further alterations. But while the dead structures are thus dealt with the disease too often keeps on advancing and infecting more and more of the lung tissue. In some cases, however, and we have seen that these are not few, the disease takes pause. The advance of the bacilli is hindered, and a process of recovery begins. The dead structures cannot be restored, but they are either expectorated or laid aside with a protecting layer of fibrous tissue around them, whilst the infected living tissue takes on a more healthy action and develops into a wholesome cicatricial tissue. What brings about this satisfactory change in the local conditions? If we enquire into the circumstances of a case where recovery has occurred we shall probably get some sort of an answer to this question. Let me give you in a few words a *résumé* of two cases in which recovery from consumption of the lungs occurred.

About five years ago a man was admitted to the Western Infirmary with acute consumption of the lungs. It seemed to be a case of galloping consumption. He was carefully looked after in the Infirmary, then passed on to a convalescent home, and afterwards, for about eighteen months did little beyond looking after his health. He slowly improved, and was for two or three years able to do some regular work. He was readmitted to the Western Infirmary with an acute inflammation of the lung, and of this he died. The *post-mortem* examination revealed that the whole of one lung had been destroyed by the tubercular disease four or five years before, but that all trace of active tuberculosis had long since disappeared.

The other case is that of a working man with whom I was somewhat intimately concerned, who was admitted to the Western Infirmary with evident signs of consumption of the lungs. Through the kindness of the students who had known him in his official capacity, he was able, after a residence in the Infirmary, to take a six weeks' voyage in the Mediterranean. This is more than three years ago, and from that time he has been fit for his work and free from any signs of active tuberculosis, although of course the permanent damage to the lungs remains.

These two cases indicate that a change of circumstances, calculated to give renewed vigour to the body as a whole, may result in the cure of the local disease. It should be remembered that, probably in every case, the tubercular bacilli are actively opposed by the living tissues of the body, they do not get leave to multiply unimpeded, and certain of the phenomena of tuberculosis are merely the expression of this opposition on the part of the living structures. There are many people in whom the bacilli are incapable of obtaining a foothold; however they may be introduced, the vigour of the living structures is too much for them. In cases where the infection has been implanted the reinforcement of the powers of the body is the means by which recovery may be brought about. The facts which I have adduced show how successfully this is frequently done. My belief is that amongst working people it frequently happens that a young man or woman is slightly affected in the lungs, not sufficiently to call for medical treatment perhaps, but enough to make him take special care. He will expose himself less, will be careful of overexertion, feeling less capable than before, will notice his food more accurately, will perhaps leave off work for a few weeks and go to the country, and these precautions are often sufficient to turn the scale against the intruding infection. But even where the disease has obtained a foothold, such cases as the two I have mentioned show that recovery is by no means impossible. I believe that hospital treatment in these cases is often of great benefit, but the ordinary wards of the hospital are not so well adapted for this purpose as might be desired. If we consider

the homes of our city working people, and the position of a consumptive young man or woman, would it not be obviously a great advantage if the patient could be taken to a Home in the country, where arrangements for his special necessities would be made, and where he might be taught a mode of life which would enable him to preserve his vigour after the disease had been overcome? This, with the other question of isolation, is one which is worthy at least of discussion.

It may occur to some that we are already past the time when measures of this kind need be discussed. It is only nine years since Koch's great discovery of the tubercular bacillus impressed the world with the truth that the most prevalent of all the forms of disease is due to a definite parasitic microbe. Already the idea is in possession of the public mind that some direct antidote to the infection is to be found. The announcement that Koch himself had discovered such an antidote was received with almost universal credence, and the world went nearly crazy over the prospect, the medical fraternity no less than their neighbours. I do not suppose that we have heard the end of Koch's remedy as yet, and we may still believe in a possible antidote; but, meanwhile, we have the great domain of preventive medicine which the discovery of the nature of the disease has opened up to us, and we have the clear indications of nature as to the mode in which the disease may be overcome, at least in many cases. Along this plain path it is surely our business to travel. Even if a direct cure for the disease be found it will still leave the persons who have been affected seriously maimed, and it will still be the business of preventive medicine to stay the infection at its source and to foster the powers of resistance in the community.

STATISTICAL FACTS REQUIRED IN THE SCOTTISH REGISTRAR-GENERAL'S MORTALITY TABLES,

PARTICULARLY WITH REGARD TO DISEASE AND MORTALITY IN REFERENCE TO OCCUPATION.

By EBEN. DUNCAN, M.D.,
Physician to the Victoria Infirmary, Glasgow.

Mr. President and Gentlemen,—It is now more than half a century since the first Registration (Births, Marriages, and Deaths) Act for England and Wales was passed in the face of considerable opposition. The success which has crowned the labours of the officials of the Registrar-General's office in England, and the great national benefits which have flowed therefrom, are fully recognized by every class of sanitarians. The masterly and eloquent reports of the late Dr. William Farr on the mortality returns of England are works of enduring interest and importance. The rapid advance of sanitary science in modern times is largely due to the light shed by his great collections of statistical tables of mortality on the distribution and causation of disease in England. It has been truly said that not only all Europe, but gradually the entire world, has been influenced by the work of that admirable man.

The success of the Registration Act in England led, in 1854, to the passing of the Scottish Registration Act, which was intended to provide for Scotland a Registrar-General's office to do in Scotland what had been so successfully achieved in England. Most useful work has been accomplished as the result of that Act, and I have no doubt that the officials of the Scottish office do their statutory work honestly and faithfully with the means at their disposal. But there is a meagreness about the Scottish

Registrar's mortality returns which hinders the elucidation of important sanitary questions—questions of serious public importance which can only be settled by statistical enquiries in the Registrar-General's office. If, therefore, it appears, on further enquiry, that the money presently at the disposal of the Scottish Registrar-General is inadequate to permit of detailed abstracts of disease and mortality being prepared and published, it will be the duty of this Association, and of every other medical and sanitary corporation, to insist on the necessary increase in the staff at the disposal of the Registrar-General for this most important purpose.

The first defect in the Scottish Registrar-General's detailed abstracts of mortality, to which I wish specially to direct attention, is that as regards two-thirds of the population of Scotland we are not furnished with any details as to the causes of mortality.

In the case of the eight principal towns of Scotland, a detailed statement is made of the numbers dying from individual diseases, and in the case of twenty-seven registration districts containing smaller towns, a very imperfectly differentiated table is given of the deaths from the chief zymotics and from three other classes of disease. In this classification of zymotics, typhus and enteric fevers are classed together, although they are as distinct in causation as scarlet fever and small-pox. It is further to be noted that there is no attempt to limit the details to the limits of a sanitary authority; it is not the municipal corporation, but the registration district, which is referred to in these tables. They do not, therefore, enable us to judge of the success or non-success of the individual sanitary authorities in the suppression of preventable disease with any degree of accuracy. I am of opinion that it is, or should be, the duty of the Registrar-General to furnish the country with detailed statements, not only of the general mortality, but also of the causes of mortality (the diseases of which the people die) within the limits of every individual sanitary authority in Scotland. At the present time the sanitary administration of the rural districts, and of the small towns and villages, requires very special attention, and it is of national importance that we should have every light which can be shed upon the mortality tables of these country districts. Two-thirds of Scotland should not be left in statistical darkness.

But it may be said that these smaller sanitary authorities and sanitary enquirers generally may obtain private information from the books of the local registrars. There are two difficulties in the way of this. In the first place, the local registrars may refuse to give facilities for any such private enquiry, as they are under no statutory duty to do so. An example of this happened quite recently in the experience of the medical officer of health for the county of Fife, who informed me that a con-

sidcrable number of the registrars in Fifeshire refuscd to givc him any information as to thc causcs of mortality in their districts. In thc second place, even wherc facilities are given, the enquiry is complicated and rendered more difficult by the fact that many of the smaller burghs and sanitary authorities are so situated that they form either part of a registration district or part of several registration districts.

Some time ago I was desirous of ascertaining the number of deaths from typhoid fever in a street in the burgh of Govanhill, but on enquiry I learned that one side of the street was in the registration district of Tradeston, and the other side of it in the registration district of Gorbals, and I had not time to toil through the books of two such populous districts to get at the facts. As another illustration of this difficulty, I was informed by my friend, Dr. Christie, that, in connection with some articles which he was publishing in the *Sanitary Journal*, on the death-rates of the watering-places on the Clyde, he found it impossible to get accurate details because of the fact that the boundaries of the registration districts, of which alone the details were kept, were not the same as the boundaries of the municipal authorities, whose sanitary administration he desired to criticise in the public interest.

It would be perfectly simple and easy for the local registrars to make the necessary distinction in their returns, and to allocate the deaths from the various diseases to the individual sanitary districts. A few additional clerks in the Registrar-General's office could make the necessary abstracts for the subsequent detailed reports. The present general mortality returns are, in the absence of detailed statements as to their causes, not only comparatively useless, but sometimes positively misleading. Our President, Mr. Fyfe, lately informed me that, on looking over the mortality tables of the town of Berwick, on the east coast of Scotland, he was struck by an exceptionally high death-rate in one particular year. When the details were examined, it was found that this exceptional rate of mortality was due to a ship-wreck with great loss of life, and not to an epidemic of preventable disease, which was the very natural presumption in the mind of our friend, Mr. Fyfe.

Another important matter of dctail which requires the attention of the Scottish Registrar-General is the mortality which occurs in our public institutions. Considerable numbers of patients die in our largc general infirmaries and fever hospitals, after a few days' residcnce. It is not a corrcct or fair procedure to credit these dcaths to the rcgistration districts in which these sick hospitals are situated, and in which thc patients may only have resided for a few days. I noticc, in the detailed mortality tablcs of thc Registrar-Gcneral of England, that the deaths which occur in the public institutions of London are separately dealt with, and allocated to thc rcgistration districts from which the patients

came. In Scotland this could easily be done in the case of the comparatively few large general infirmaries and fever hospitals which exist for the benefit of a large area of the surrounding districts. The details of the population of every municipal authority, and of all the large public institutions in Scotland, are furnished in the census returns, and I know of no adequate reason to prevent the compilation of mortality tables giving accurate and authoritative details of the deaths in these corporations and public institutions.

I now come to the important subject of the registration of disease and mortality in reference to occupations. No attempt has ever been made by the Scottish Registrar-General to furnish us with mortality tables showing the causes of death, and the comparative rates of death amongst the professions and trades of the people of Scotland. For forty years this subject has been attended to in the office of the Registrar-General of England, and he states that, in his opinion, this subject is "Next to none in importance in an industrial country." With this opinion I entirely agree. As a result of the admirable detailed tables on this subject compiled by the medical statisticians of the English office, and published in the Decennial Supplements to the Registrar-Generals' reports, the dangers peculiar to unhealthy occupations have been ascertained, and the means by which these dangers may be prevented have been discovered. In this way fatal diseases and high death-rates have been diminished in large classes of unhealthy trades, to the benefit of the national health and of the national wealth, and to the material diminution of human suffering.

A great deal still remains to be done, and still greater detail is necessary before we can accurately apportion in a trade mortality the respective effects of handling of poisonous materials, of insanitary methods of working, and of the bad hygienic influences of ill-constructed workplaces. What we require from the Registrar-General is, not only the general mortality of every trade or occupation which engages large numbers of workers, and which can be well differentiated from other trades or professions, but wherever there is found to be a marked increase in the mortality of a trade, from a particular class, or from particular classes of disease, we must have a detailed statement of the deaths from the individual diseases which form the class or group of diseases in question. We must also have the proportion in which the workers die from these specially fatal complaints at different age periods, from the time of their apprenticeship onwards. All this has been more or less successfully attempted by Dr. Ogle in the Registrar-General's office in England. In the census returns for Scotland, full details are given as to the number and sexes of persons in different occupations, and also as to the numbers alive at different age periods. From these census

tables the sanitary enquirer can obtain valuable information as to the comparative numbers of persons in different trades who survive a given age. In this way we can arrive at an approximately correct opinion as to the comparative longevity of different classes of men. What we require from the Registrar-General is a statement from which we may find out the causes of the differences in mortality, and thereby the reasons why in some trades comparatively few men survive the age of 45, and a man who reaches the age of 65 is an exceptional phenomenon of great rarity.

It is only in census years that accurate returns can be got as to the numbers of persons engaged in different occupations in this country, and it is, therefore, only in census years that any profitable enquiry can be made as to trade mortalities. For this reason it is only in the Decennial supplements of the Registrar-General of England that detailed tables of trade mortalities appear. He gives also in these supplements summaries of the accumulated statistics of the office, with regard to the geographical distribution of disease, and with regard to the incidence of special diseases, such as cancer, diabetes, scarlet fever, and diphtheria.

Another serious defect of the Scottish Registrar-General's reports is, that he issues no Decennial supplement, and thus ignores the possibilities of an accurate record in summary form of mortalities, either with regard to trades or any other aspect of the mass of interesting details committed to his care. All this mass of collected statistics of vital importance to the public health remains neglected and unfruitful, and in this regard the Scottish Registrar-General may be compared to the unprofitable servant in the parable of the talents.

With regard to the want of detail in the matter of trade mortalities the medical statistician of the Scottish Registrar's office writes as follows, in reply to a letter of enquiry which I addressed to him as to the reason for this omission. He says:—"The drawing up of such would not, I think, in the majority of cases (on account of the comparatively small population of Scotland), give even such estimates as the like does for England; for, as you know, the smaller the members one has to deal with, the less reliable are the issues to be deduced therefrom." Admitting this, nevertheless I hold that Scottish statistics would be of great value either in corroboration of, or in correction of the English tables. Further, they are essential in the interests of those engaged in unhealthy industrial pursuits, in which there are differences in the materials used, in the methods of working, and in the hygienic surroundings which are peculiar to Scotland. For example, quite recently I was engaged in an enquiry as to the trade mortality of plumbers as compared with other workmen in the building trades. Of course, I could get no information from the reports of the

Scottish Registrar-General, but in the English Decennial Supplement of 1871-80, I found a table in which, for the three years 1880-81-82, the mortality of the class of plumbers, painters, and glaziers was compared with the mortality of men of ninety-nine other trades and professions, and I found another table in which details were given as to the special diseases which made up the total mortality of these tradesmen at the period of life when they were most likely to suffer from the effects of their occupation. It is the details of the latter table which makes it important, and which enabled me to show not only that this group of workmen suffered more than others from lead-poisoning, but, further, that chronic lead-poisoning, short of producing directly a fatal result, killed by inducing disease of the kidneys, of the heart, and of the nervous system. A number of important deductions in this and other directions lead directly to important results in the prevention of this excessive mortality amongst workers in lead. But the English Registrar-General was unable to separate plumbers from painters, because in England the same man does both classes of work, whereas in Scotland plumbing and house-painting are distinct branches of industry. The question, therefore, as to which of these branches of industry is most liable to suffer from these diseases can only be settled by Scottish statistics. There are nearly 7,000 plumbers in Scotland, and about 11,000 painters, so that if we had the returns there could be no difficulty in arriving at a just conclusion on this question. Then there is the question as to how far plumbers, who are constantly exposed to sewage gases, suffer from such diseases as typhoid fever and diphtheria, diseases which are supposed by many sanitarians to be specially caused by such emanations. This is another question which can only be settled by Scottish statistics. I instance this as one example of a trade in which benefit might be derived from the publication of a Scottish Decennial Supplement giving tables of trade mortality for the census year, the year preceding it, and the year following it, during which three years we may presume that the average numbers of the workmen will be very much the same, and can be ascertained with accuracy. No doubt there are many other trades in which Scottish statistics might be equally serviceable. To my enquiry as to the reason why no Decennial Supplement has been issued in Scotland, the following reply comes from the medical statistician of the Scottish office:—"It has long been considered that, with the information given in the detailed annual reports, the issue of a Decennial Supplement is not necessary, as from these it is believed that the important facts in connection with births, deaths, and marriages in Scotland are so stated, that more detailed information for any series of years, if required, may be obtained therefrom; and, moreover, the staff at the disposal of the Registrar-

General will not permit of such extra work being performed." With regard to disease mortality in relation to occupation, I have shown you that there is no information whatever given in these reports, and with regard to two-thirds of the population of Scotland, the details given are quite inadequate for the purposes of the modern sanitarian. The above statement is, therefore, only partially correct with regard to the eight principal towns.

The aims of the Registration Acts, with respect to mortality returns, were admirably stated in the first reports of the Registrar-General of England. They embrace—firstly, a more accurate knowledge of the comparative prevalence of mortal diseases; secondly, of the localities in which they respectively prevail; thirdly, of the age and sex; and, lastly, of the conditions of life which each principally affects. Since that time the returns of the Vaccination Department have been added to the reports of the Registrar-General of Scotland; and I would now strongly urge that, in addition, a department of the Registrar-General's office should be devoted to the registration of the cases of zymotic disease which are notified to the various sanitary authorities, and the preparation of comparative tables showing the geographical distribution of these diseases in Scotland. I am of opinion that the addition of tubercular diseases to the list of contagious diseases to be notified would assist us greatly in solving many important questions with regard to the means by which these widely prevalent and destructive diseases are spread. The knowledge so obtained might point the way to the means to be employed for their prevention.

I believe that all the sanitary benefits that can be gained from the meagre details with which we have been furnished in the past have been gained. If this elaborate machinery of registration of births and deaths is to be maintained in Scotland, the expenditure of public money upon it must be justified. It is not creditable to Scotland that, when Scottish sanitarians, in the health interests of their fellow countrymen, desire any reliable statistical information beyond the most elementary facts of general rates of mortality, they are compelled to search the mortality tables of other countries to obtain it. If the staff at the disposal of the Scottish Registrar-General, and the money at his command, are insufficient, we, who represent in a large measure the sanitary interests of Scotland, must agitate until the means to carry out the necessary work are supplied. I am informed that the Secretary of State for Scotland has the power to frame regulations for the conduct of the Scottish Registration Office. If you, gentlemen, approve of the reforms which I have advocated in this paper, let us petition the Secretary of State to frame the needed rules, and, if necessary, let us ask Parliament to provide

the money required to have these reforms carried into effect. I am certain that the paltry sum needed for a few additional clerks in the Registrar-General's office, and for the expense of printing summary tables, would at once be granted, if the great public importance and utility of such statistical enquiries were properly represented by this Association to our Scottish Secretary and our Scottish Members of Parliament.

DISPOSAL OF VILLAGE SEWAGE.

By JOHN D. WATSON, Esq., C.E., Assoc. M. Inst. C.E.,
County Sanitary Inspector, Aberdeen.

The impetus given to sanitary science by placing the administration of the Public Health Acts in the hands of County Councils has been very considerable, and we now find ourselves face to face with problems which, but a short time ago, were rarely mentioned, and much more rarely grappled with. The introduction of an ample and wholesome water supply and the effectual disposal of village sewage are perhaps the most difficult, because the most costly questions which come before District Committees.

The provision of a good water supply frequently involves works of no little difficulty, but civil engineers are generally agreed upon the best methods to be adopted in introducing water to a town, whether by pumping or gravitation, whereas there has hitherto been quite a want of unanimity among them regarding the best mode of disposing of sewage—due, however, to the differences which have existed among chemists rather than to any want of decision on the part of engineers.

There are few villages in Scotland where the drainage systems are complete and satisfactory from a sanitary point of view. The great majority of those in which I am more particularly interested are only partially sewered, and these sewers are almost invariably short lengths of pipe (often agricultural tile pipes) and drains built of rubble stones which lead to no special or recognized outfall, laid probably to overcome the exigency of the moment, and without the slightest reference to continuity or the establishment of a system which would ultimately be complete.

There cannot be two opinions about the unwisdom of allowing this state of affairs to continue, but in view of the large amount

of more pressing work which County Councils have on hand, it may not be necessary to deal with this in wholesale fashion. Existing "systems" should be allowed to remain so long as they work passably, but every extension or alteration which is necessitated should be made upon permanent lines. This would ultimately lead to connected and complete systems, which succeeding members of District Committees would find it to be to their interest to follow and perfect. In reporting to my Board on this matter, in the month of January last, I submitted the advice that "plans should be made of drainage systems, in so far as they may be said to exist, throughout the county, and that there be laid down on these same plans a proposed system of sewerage which, when approved, shall be the basis for every extension and alteration made in the future."

It must be recognized at the outset that, in order to deal effectively with the sewage of a village, it is absolutely essential that the sewage be led to one outlet and there disposed of by irrigation, precipitation, or otherwise. While the method, or rather want of method, which obtains so universally at present, of having a large number of outlets leading into and on to all kinds of places, there is no hope of being able to deal satisfactorily with the question. I would, therefore, urge upon every county inspector the wisdom of cautioning Standing Joint Committees against granting their consent to works which do not show this point to be the very basis of the projected scheme—unless, indeed, the village is situated on the coast, where there might, under certain circumstances, be a positive advantage in having more than one outfall.

In this country the method of sewering towns of all sizes and conditions has been based almost invariably upon the principle of removing surface and storm waters as well as sewage. So long as it was possible to run all this liquid direct into the nearest stream, without question there was little occasion for considering whether or not both waters should be carried off by the same conduit, but from the moment that it is determined to exclude sewage from streams under all circumstances, this question will present itself for solution.

The main advantages to be derived from the adoption of what has been termed the separate system are chiefly (1) that smaller sewers may be employed, and (2) that regularity of quantity and quality may be estimated with greater accuracy. These are by no means mean advantages where the sewage is ultimately disposed of by irrigation or precipitation, but I hesitate, notwithstanding, to recommend any village or small town to adopt the separate system as a *system*. If, as may be found occasionally, old built drains (which formerly were the only sewers) are quite suitable for carrying off storm and surface water, and if there is little probability of their position being altered by the

Road Board, it will be for the county inspector to consider whether it would not be advantageous to employ these built drains to convey surface water to the nearest stream.

Where populous places are situated on the sea-board, there should be no difficulty in disposing of sewage and surface waters, provided that the engineer selects a suitable site for the outfall sewer, constructs it of cast-iron, and places the mouth at a point not higher than the level, midway between high and low water marks. But for one village on the coast, there are many villages inland which have neither sea nor tidal river to assist in effectually getting rid of the sewage, and it is with such cases that our difficulties arise.

It appeared to our forefathers that the speediest, most natural, and most effectual method of disposing of sewage was to convey it to the nearest stream, regardless of whether the water, or any quantity of it, was likely to be abstracted by people farther down the stream for domestic purposes, and this practice obtains to a very great extent even where the sewage of comparatively large towns is concerned.

To this state of things we have three very powerful objections. (1) That it is detrimental to public health, (2) that it is illegal, and (3) that it is antagonistic to public sentiment.

Any one of these would cause a District Committee to hesitate before they proposed to contaminate a limpid stream, and if all three were established, no such proposition would get beyond the Standing Joint Committee of a County Council.

Purification of sewage involves so great an expenditure of money, that strong efforts are being put forward (and may be continued) to prove that too much is being made of the question of pollution as it affects health.

According to the *Deutsche Bauzeitung*, 18th February, 1891, a remarkable investigation was made by Professor von Pettenkofer, with reference to the sewage pollution of the River Isar, between Munich and Freïsing. Observations were made during a time when the river was in flood, and also last winter, when it was abnormally low, and consequently when the proportion of fæcal matter in relation to volume was greatest. The relative volume was as follows :—

At lowest level,	.	.	50 cub. metres per sec.
,, mean ,,	.	.	189 ,, ,, ,,
,, highest ,,	.	.	359 ,, ,, ,,

A comparison was made between the amount of oxygen that was required to destroy the organic substances in the water when the river was at its lowest, and the amount that was required when it was at its highest or in time of flood, and the observations of Professor von Pettenkofer led him to conclude that the water was much freer from pollution when the river was low than when it was in flood. He affirms that he does not believe that evil

results follow the discharge of raw sewage into the river, retreats from the contrary opinion which he formerly held, and undertakes to prove that bacteriological investigations do not support the theory that harm is done to the river by the discharge of sewage. Munich is a town with a population of 270,000.

In reading a paper before the Engineering Section of the London Congress of Hygiene last month, Mr. Baldwin Latham, C.E., said :—" The experience in India in connection with water supplies taken from rivers shows that the rivers undergo a process of purification, and that the waters taken from them, after a sufficient length of flow and proper filtration, are amongst the most wholesome supplies in the country, as the case of Calcutta fully demonstrates. And yet," he adds, " the running streams of India, to which the natives have access, are polluted from their source downwards, but, as a rule, the districts supplied from running streams are healthier than those drawing their water supplies from either tanks or wells."

Against these opinions we have equally recent expressions of opinion from Professor Robinson, C.E., Mr. Binnie, Chief Engineer to the London County Council (who has had considerable experience as a water engineer in India), and also from Professor Frankland, who read at the Congress a valuable paper on " The Present State of Our Knowledge Concerning the Self-Purification of Rivers," in which he quoted the experiments of the Rivers' Pollution Commission on the Irwell, Mersey, Derwent, and Thames, and his own experiments on the Thames and Ouse, to show that all these experiments negative the theory of self-purification as regards dissolved organic matter, although unmistakable improvement is traceable in the case of suspended matter. He also referred to the experiments of Hulwa on the Oder, near Breslau, Frank on the Spree, at Berlin, and Prausnitz on the Isar, at Munich.

Hulwa supports the theory of self-purification, Frank limits it to suspended matter, and Prausnitz adopts an intermediate view. Dr. Frankland also pointed out that equanimity exists with regard only to self-purification by sedimentation, a process which can never guarantee the absence of danger, inasmuch as a flood is liable at any time to disturb the bed of a stream in such a manner as to raise the microbes and spores which had there obtained a lodgment. He held that of the removal of dissolved organic matter there was no evidence. In the discussion which followed the paper, there was very general assent to the views expressed by Dr. Frankland.

It must be admitted that the bulk of the chemical evidence leads to the conclusion that there is real danger in drinking water which has been polluted by sewage, and that the elements of danger are only lessened, not destroyed, by rendering sewage inappreciable from its uniting with a great body of pure water.

But even if it were established beyond question that a water once polluted may be rendered altogether innocuous by natural or artificial means, public opinion is so powerful, and sometimes so fastidious, that it would be difficult to persuade a community to use a water for domestic and dietetic purposes which was well known to be contaminated with foul matters.

An eminent analytical chemist, in reporting upon the question of whether it was deleterious to a pure stream to allow a quantity of sewage to flow into it, arrived at the conclusion that the contamination was altogether inappreciable some distance down the stream, and that the waters might safely be used for drinking purposes; but, in reporting his conclusions, he described the bed of the stream at the place of pollution, detailing the appearance of sewage particles, *vorticellidæ* and *tubifex rivulorum*, in such a manner that the report, instead of having a reassuring effect, created prejudice against the waters of the stream.

While I distinctly deprecate supplying a village with the water of a stream which has been contaminated in its upper reaches, when it is possible to obtain water from an undefiled source, I attach so much value to the provision of an abundant supply of soft water for dietetic, cleansing, and flushing purposes, that I should weigh very carefully the chances of danger to health from using water in which an occasional microbe or spore may exist, against the certainty of the danger to health from ill-flushed sewers and personal uncleanliness.

If it depended solely upon the question of whether water which has once been polluted by sewage can, under any circumstances, be used as drinking water, we might not be compelled to occupy our minds with the question immediately, but the Rivers' Pollution Act enacts that "every person who causes to fall or flow, or knowingly permits to fall or flow, or to be carried into any stream, any solid or liquid sewage matter shall (subject as in the Act mentioned) be deemed to have committed an offence against this Act. The qualification referred to is to the effect that if the accused shows to the satisfaction of the court that he has used the best practicable and available means to render harmless the sewage matter falling or flowing into the stream," he shall be acquitted. Of course, it is evident that both questions are inseparable, inasmuch as a County Council or District Committee would hesitate to enforce the provisions of the statute against any one—more particularly themselves, as in case of villages—unless they were satisfied that there were tangible reasons for so doing.

We come, therefore, to consider the question, "What is the best practicable and available means of rendering harmless sewage matter?"

In Aberdeenshire we have been deeply interested for several months in the alleged pollution of the River Dee, and by the

instruction of the Chairman of the Public Health Committee, I prepared a report upon the best means of dealing with village sewage.

In that report (a copy of which I lay on the table),* I stated at the outset that the conclusions at which one arrived depended almost altogether upon the sources from which his information had been drawn and the experiments that had come under his notice. I had, therefore, deemed it advisable to communicate with a large number of small communities, both in England and Scotland, in order to ascertain the exact position of the question at the present time.

Four hundred circular letters were sent out and 182 were returned, with answers to our queries. From the replies which we received, 86 were tabulated and printed, and these were selected for the simple reason that the others—96 in number—were for the most part statements to the effect that the sewage of the places, to which they referred, was allowed to gravitate towards neighbouring streams without treatment of any kind. The following is a summary of the replies received :—

At 50 places *irrigation* is adopted in one form or another, and sewage in its crude state is applied to the land.

At 24 places *precipitation* is adopted, the following system being used—viz., alumino-ferric (4), the "Amines" process (1), Hille's fluid (1), chloride of lime and iron (1), lime (7), ferozone and polarite (4), Smith's sodium process (2), sewage is said to be treated chemically (4).

At 6 places *natural* or *mechanical subsidence* is adopted, and the effluent is thereafter passed into a river or on to a small piece of land.

At 2 places *mechanical filtration* is adopted.

At 6 places the *dry-closet system* is adopted.

At 1 place *cesspools* are in vogue.

It should be mentioned that requests were made for replies to our queries only where the town or village was believed to have a population of 20,000 or under, the reason for this restriction being that a town of 100,000 inhabitants might have found a particular manner of treating a large quantity of sewage quite satisfactory, when similar treatment would have been quite unsatisfactory in the case of a small town or village; or conversely, and perhaps more correctly, a place of 1,000 inhabitants might dispose of its sewage by, say irrigation, when a town of a hundred times that size would find such a course perfectly impracticable. This rule was disregarded only in a few exceptional cases, which, I had learned, were actually making a profit out of the disposal of their sewage. I therefore made special enquiry, eliciting the information that profit is hardly ever to be thought

* This report has been published *in extenso* by the Board of Supervision in their Forty-sixth Annual Report.

of in connection with the effectual disposal of drainage water, and, where profit has been made, it invariably was the result of good "sewage farming."

I beg to notice a few points which occur to me as particularly worthy of attention in the returns which we received, and as bearing directly upon the problem which will present itself to a Local Authority when they are called upon to take up the subject of River Pollution.

1. It is an important fact that of the 182 replies which we have got, nearly one hundred Local Authorities do next to nothing to purify the sewage of the town or village they govern. This seems to indicate that neither the Local Government Board in England nor the Board of Supervision in Scotland have been active in causing Local Authorities to carry out the provisions of the Rivers' Pollution Act; and it may safely be inferred that Local Authorities have taken action only when the health of the community generally was suffering by the sewage contamination, or when proprietors of the streams affected, or others having *locus standi*, have sued for interdict in the law courts.

2. The decided preference for *irrigation* in one form or another as the most effectual means of disposing of sewage is one of the features of the returns. That this should be so is not surprising to me. Land irrigation is at once the most natural, the best, and the cheapest method of disposing of towns' sewage, unless, perhaps, when it is largely diluted with chemicals from manufactories, or when land for the purpose cannot be readily obtained.

3. It has to be noted that, in the comparatively few cases where *precipitation* is recommended, there is a great lack of unanimity in putting forward a particular system.

Considering the fact that there have been several scores of patents taken out for purifying and rendering harmless sewage liquid, it is somewhat remarkable that so few of those patent processes are recommended by responsible surveyors and inspectors, and it is also noteworthy that in no case where a particular chemical or method of precipitation has been recommended, is that method of long standing—emphasising the fact that of those methods which have been put into practical operation, a limited number only have attained more than transitory existence; and these returns again bear out in a remarkable manner the truth of the conclusions to which the Royal Commission on Metropolitan Sewage Discharge (Lord Bramwell's) arrived, when they reported that "several processes appear to be fairly effective, but that there has been no evidence to satisfy us of the marked superiority of any one in particular."

4. A summary of the appendix also shows that land irrigation is a much cheaper operation than precipitation, presuming, of course, that land can be got at a reasonable cost, and that it does not require too much labour to convert it into a fit condition for

receiving sewage; and it should not be forgotten that even clay soil is fit to be used for irrigation if properly prepared. One of the results of the Society of Arts Conference on the Health and Sewage of Towns (1876) was expressed by the Committee as follows:—"In certain localities, when land at a reasonable price can be procured with favourable natural gradients, with soil of a suitable quality and in sufficient quantity, a sewage farm, if properly conducted, is apparently the best method of disposing of water-carried sewage. It is essential, however, to bear in mind that a profit should not be looked for by the locality establishing the sewage farm, and only a moderate one by the farmer."

5. That the sludge precipitated is got rid of with difficulty, even where no charge is made for it. When farmers take it away they do so at times convenient for themselves, and it frequently lies in great heaps for many months of the year. The chemical used for precipitation sometimes destroys the fertilizing qualities of the sludge, and occasionally, on the contrary, it is said to improve it; but, speaking generally, the sludge is hardly worth more than cartage from the tanks to the farm.

That improvements are likely to be effected upon the present system of treating sewage by precipitation and filtration is more than probable, but in the present state of knowledge and experience, I am compelled to accept the conclusion that broad irrigation, assisted occasionally by intermittent downward filtration, is the most effectual, the cheapest, and most generally suitable for the disposal of the sewage of our villages.

It would be impossible to recommend any system which would be equally suitable to all towns and villages, as circumstances vary so much at different places, but where the following conditions obtain, there need be little hesitation in adopting broad irrigation, viz.:—(1) When land can be got at a convenient distance from the village. (2) When the area of the ground is not less than 1 acre per 100 of population. (3) When the ground is of an open gravelly nature. (4) When the gradients are suitable in respect of natural declivity from the village to the farm, and where the land readily yields itself to being formed into an easy slope.

When all these conditions unite, and the Local Authority are fortunate enough to obtain a good tenant to manage the farm, I should expect the cultivation of the land to yield more than the expense of management and interest on capital outlay.

Seeing that it is quite impossible, in a paper of limited length, to treat the subject in an exhaustive manner, I have endeavoured to refer to those points which ought to impress themselves upon us before we form a judgment which will be subjected to the criticism of a County Council and of the public.

NATIONAL REGISTRATION OF PLUMBERS, AND ITS RELATION TO THE PUBLIC HEALTH.

By ALEXANDER MALCOLM SCOTT, Esq.,
Solicitor, Glasgow,
Secretary to the Plumbers' District Council for Glasgow and the West of Scotland.

Origin of the Movement.

At the International Health Exhibition in London in 1884, a remarkable conference was held *in the interest of the public health of the United Kingdom.* It was a conference, largely and influentially attended, of plumbers from all parts of the country, and representatives of various classes interested in sanitary arrangements, the object being to consider whether something practical could not be attempted to cure the evils arising from insanitary conditions of dwellings. The Conference was unanimous in thinking that, for the protection of the public health, an attempt, on a wide basis, should be made to elevate, by registration and education, the craft of the plumber, and certain resolutions were passed accordingly. The practical outcome of the Conference was the formation of a large and widely representative general council to give effect to these resolutions. What this General Council chiefly resolved upon was a system of registration of plumbers; and, with the cordial approval of the Council, there came to its aid the Worshipful Company of Plumbers, London, being the only chartered body of the craft in the country, and which was instituted in the reign of Edward III, A.D. 1365, for the regulation of the trade. The Company, at the desire of the General Council, undertook the work of registration, and to spend its own corporate funds in the

work. The Company, however, in carrying on the work of registration, does so by means of large councils, which are representative of the various clssses interested in sanitary matters. It was in this way, then, that the national registration of plumbers originated.

Progress of the Movement.

The movement has since spread all over the three kingdoms. There are upwards of 30 District Councils in England and Ireland, and the whole of Scotland is covered by six District Councils for the purpose of overtaking its portion of the work of registration. These Scottish District Councils are as follows :—

1. Glasgow and the West of Scotland.
2. Edinburgh and the East of Scotland.
3. Forfarshire, Fifeshire, and Perthshire.
4. Aberdeenshire, Kincardineshire, and Banffshire.
5. Inverness and the North of Scotland.
6. Dumfriesshire, Kirkcudbrightshire, and Wigtownshire.

Each District Council is composed of an equal number of master plumbers, operative plumbers, and public representatives. Public representatives are selected from the magistracy of towns, sanitary authorities, architects, and others, and the object of having them on the Council is to assure the public that their interests will be looked after in this system of registration, and that the utmost fairness and impartiality may be secured to both the trade and the public.

By way of illustrating the character of the composition of the public representatives' section of a district council, the case of the Council for Glasgow and the West of Scotland may be taken. In that Council the present public representatives' section consists of (1) the ex-Lord Provost of Glasgow, (2) the Chairman of the Health Committee of Glasgow, (3) the ex-Chairman of the Health Committee of Glasgow, (4) the Glasgow Medical Officer of Health, (5) the Glasgow Sanitary Inspector, (6) three members of the Glasgow Institute of Architects, (7) a member of the Glasgow Faculty of Physicians and Surgeons, (8) one of the Professors in the Glasgow and West of Scotland Technical College, (9) a member of the Glasgow Faculty of Procurators, (10) the Chairman of the Glasgow School Board, (11) the President of the Glasgow Institute of Measurers.

These District Councils have nothing whatever to do with any plumbers' trade societies or trade organizations. *They exist really for the benefit of public health.* They are popularly elected bodies, and have very large powers. Committees of the Councils also exist in various centres in the districts for the purpose of getting the trade in the remotest places thoroughly interested in

the movement. All the Scottish Councils meet in Congress once a year for the discussion of matters affecting the movement, and especially its working in Scotland. The Congress this year was held in Glasgow, under the Chairmanship of the Convener of the Health Committee of the City, and attended by about 50 delegates, including your own President, Mr. Fyfe. These District Councils exhibit the unique feature of master and operative cordially working together, and of the operative having an equal voice with the master.

Functions of the District Councils.

While these Councils are, for the sake of unity, subject to general regulations applicable to the United Kingdom, the powers and functions they possess are nevertheless very considerable. For instance, they receive and dispose of all applications for registration; they may, in their discretion, reject applications; from their own body are appointed examiners for the examination of applicants for registration; they hold periodical, practical, and technical examinations of applicants; they alone nominate applicants for registration; they issue to successful applicants the certificates of registration sent out by the central authority, which has already sent out upwards of 7,000 of these certificates; they receive and disburse all fees; they promote, and assist by grants and prizes, technical education for plumbers throughout their respective districts; they arrange for public lectures and addresses for the benefit of the older craftsmen, and for popularizing the movement; they make up annual rolls of registered plumbers, and circulate these among registered plumbers, architects, measurers, sanitary authorities, and others. There are numerous incidental matters also that the Councils have to attend to.

Mode of Carrying Out Registration.

The District Councils having been formed at different times, there is not *at present* a uniform system of admitting applicants. In the earliest formed Councils all qualified plumbers were invited to apply, and if satisfactory evidence were submitted that applicants were practical craftsmen, they were admitted. But this was accompanied by intimation that after a certain date the ordeal of examination would be necessary. Accordingly, in the case of the older District Councils, examination is now the rule. Taking again the case of the Glasgow and West of Scotland District Council for illustration, the admission of applicants for a considerable time has depended entirely upon a practical and technical examination, which, for the convenience of the applicants, has been held on a Saturday afternoon, and lasts about

five hours. Four examiners—two masters and two operatives—conduct the examinations. Ere long, admission to the register will everywhere depend upon careful and uniform examination.

To What Extent, and in What Manner, is Technical Education Provided to Plumbers?

Wherever a technical college exists, it has been the endeavour to institute a plumbing class; and, in towns where there is no college, plumbing classes have also been established. The result is that since this national registration movement began, a vast number of such classes have been established over the country. In these classes the governing principles of the varied work of the plumber are taught by lecture, illustrated by diagram, and, to some extent, by special workshop practice. The classes have been greatly taken advantage of by the younger members of the trade, who are required to compete in home exercises, including drawing, and in the writing of essays on given subjects. Without unduly troubling you with statistics, I shall take the case of the evening classes in connection with the District Council for Glasgow and the West of Scotland, to which the Council gives considerable grants and prizes. These classes are two in number. One of them is held in the Technical College Buildings in Glasgow, and has been three sessions in existence; the other, which is affiliated to the Technical College, is held in one of the public schools in Greenock, and has existed two sessions. Last session the Glasgow and Greenock classes together had 130 matriculated students, with an average attendance of upwards of 100. The technical and practical examinations of the City and Guilds of London Institute for these two classes were held in May of this year. About 80 of the students submitted themselves to the technical examination, which lasted three hours, and of that number there have been 45 passes—11 in honours and 34 in the ordinary grade. Out of 20 of the students who took the practical examination—four hours' work—there have been 19 passes. In the honours grade there are two prizes for the United Kingdom. The first is £3 in money, with a silver medal, and it was gained by a student of the Greenock class. This student last year took the second prize in the ordinary grade. In the ordinary grade there are five prizes for the United Kingdom; and the third—£1 in money, with a bronze medal—was gained by a Glasgow student. Certificates are also granted by the Institute for the remainder of the passes.

While much good is being derived by the public from the Registration movement, it is of course in the future that *its fullest benefit* to the public health will be felt, when the rising generation of plumbers all over the country shall have been technically

as well as practically trained. A scheme is being matured in connection with technical training, whereby it is intended that the examinations shall lead up to the registration of every plumber that has successfully gone through these.

The Cost of the Movement to the Plumber.

A qualified master plumber has to pay for his certificate of registration £2, 2s., and an annual fee thereafter of 10s. 6d. A qualified operative plumber pays 10s. 6d. for his certificate, and an annual fee thereafter of 2s. 6d. The students attending plumbers' technical classes pay a nominal fee. It will thus be seen that the movement, as regards cost, cannot be considered burdensome to the plumber, and it should be remarked that a very considerable sum has been expended by the Plumbers' Company in bringing the movement up to its present position.

Advantage of a System of Registration Applicable to the Three Kingdoms.

Just as in the case of medical men, chemists and druggists, and others, so in the case of plumbers, *it is essential that there shall be a uniform standard of qualification and a common form of diploma for the United Kingdom.* Examinations are uniform over the country. As the movement is one *of pure utility, and not individual nationality,* registration can only be effectually carried out by one system applicable to the whole of the United Kingdom. This is quite recognized by the trade ; for plumbers, like the doctors, desire that their diploma shall be the immediate mark of their competency all over the country and in the Colonies. The movement has been endorsed and advocated by general medical councils, by municipal and sanitary authorities, by the master plumbers, by plumbers' operative societies, by the annual Trades' Congress, and by the recently held International Congress of Hygiene, in London, presided over by the Prince of Wales.

Employment of Registered Plumbers.

Many authorities and large employers, where plumbers are required, permit none, in the interest of public health, to work who are not registered ; and registered plumbers, in virtue of their qualification, are getting responsible situations outside the trade, such as sanitary inspectors, waterworks inspectors, &c. The architects all over the country have most cordially supported the movement. As an instance, reference may be made to the

Glasgow Institute of Architects, who, some time ago, passed a resolution that registered plumbers for all new work should get the preference.

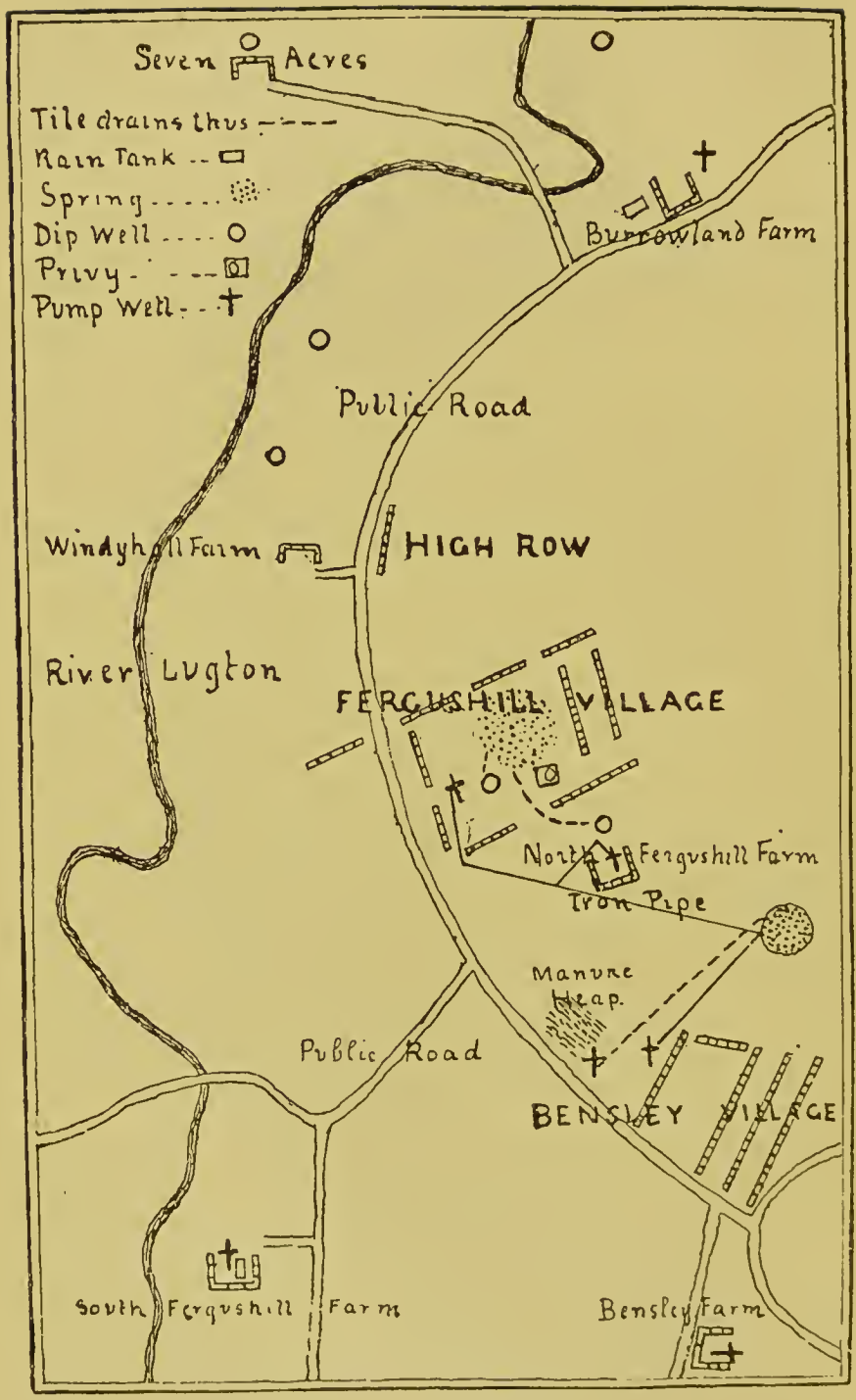
Why Parliamentary Powers are Needed for the Registration Movement.

Hitherto no Parliamentary sanction has been asked for the National Registration of Plumbers. It was felt by many, at the very initiation of the movement, that it would be impossible to carry out a system of registration on purely voluntary lines, and it was considered that, in any event, Parliamentary sanction ought not to be applied for until the organization of the movement throughout the United Kingdom should be fairly complete. That is now the case, and the time is ripe for introducing a bill into Parliament, in order to obtain the necessary disciplinary powers for the satisfactory carrying on of the system. In working out the system many cases have occurred where disciplinary powers were essential, and it is desired by the trade that a Parliamentary measure should be passed. At a special meeting of the International Congress of Hygiene, the following resolution, proposed by the Lord Provost of Edinburgh, seconded by Councillor Crawford, Chairman of the Health Committee of Glasgow, and supported by Sir Charles Cameron, Medical Officer of Health for Dublin, the Mayor of Manchester, and other speakers, was unanimously carried—viz., "That this special meeting of the International Congress of Hygiene, assembled to consider the necessity for securing the greater sanitary efficiency of the plumber's work and drainage of dwelling houses and other buildings, desires to record its opinion that an organized and efficient system of registration of qualified plumbers is essential to the protection and preservation of the health of the community, and that such a system having been established in the chief cities and towns of Great Britain and Ireland by the Worshipful Company of Plumbers, London, and the plumbers and sanitary authorities of those places, the time has now arrived when application should be made to Parliament for powers enabling a council of competent jurisdiction and authority to take measures for systematically promoting technical education among plumbers in all parts of the United Kingdom, and regulating the practice of those plumbers who are enrolled as registered plumbers."

It is not expected that any difficulty will be experienced in passing such a bill through Parliament, as the Local Government Board has already indicated its hearty willingness to co-operate for the purpose of getting the bill passed. The bill has been drafted, and it has received the approval of this year's Glasgow Congress of the Scottish District Councils and of all the other

District Councils who have considered it. It is not intended that the bill shall act compulsorily upon the trade, its sole object being, as stated in the resolution of the International Congress of Hygiene, to procure powers for the formation of "a council of competent jurisdiction and authority to take measures for systematically promoting technical education among plumbers in all parts of the United Kingdom, and regulating the practice of those plumbers who are enrolled as registered plumbers."

It will thus be seen that the Registration movement and the proposed bill are in the interest of the public health of the country, and therefore entitled to the unanimous and hearty support of all sanitary authorities.


Seven Acres
Tile drains thus
Rain Tank
Spring
Dip Well
Privy
Pump Well
Burrowland Farm
Public Road
Windyhill Farm
HIGH ROW
River Lugton
FERGUSHILL VILLAGE
North Fergushill Farm
Iron Pipe
Manure Heap.
Public Road
BENSLEY VILLAGE
South Fergushill Farm
Bensley Farm

HOW TYPHOID FEVER SPREADS.

By A. MILROY, M.D. Durham, D.P.H., and F.F.P.S.G.,
Kilwinning.

The villages of Fergushill and Bensley, consisting of rows of houses inhabited by colliers, lie 2½ miles to the north-east of Kilwinning. In the year 1881, according to the census then taken, the inhabitants of Fergushill numbered 537 and those of Bensley 318. These two villages lie 650 yards apart, and are situated on the side of the highway. Each village up until 1884 had its own well. The one at Fergushill was an ordinary dip-well, fed by tiles from a spring in the centre of the square of colliers' houses. The water of this spring, like many others similarly situated, had an extraordinary repute for purity, as it was said to filter through a thick bed of sand before coming to the surface. The well at Bensley lay to the dip of the houses, and was fed by tiles from a spring in a field about 200 yards to the north, but also to the dip of the village. The water of this spring, like that of Fergushill, was also held in great repute, because of its purity and because my lords and ladies long ago used no other water in Eglinton Castle. This Bensley well lay on the side of the public road, was covered, and had a pump on it.

The proprietors of the villages got these waters analysed by Dr. W. Wallace, then Public Analyst for Glasgow, who found the following amongst other ingredients:—

Bensley Pump Well.

(*Analysed 19th October, 1877.*)

	Grains per Gallon.
Total solids,	= 23·10
Volatile and organic matter,	= 2·62
Chlorine,	= 2·73
Nitric acid (N_2O_5),	= 1·50
Oxidizable organic matter,	= 0·08
Free and saline ammonia,	= 0·003
Ammonia as organic nitrogen,	Trace.

FERGUSHILL VILLAGE DIP-WELL.

(*Analysed 19th October, 1877.*)

	Grains per Gallon
Total solids,	= 25·55
Volatile and organic matter,	= 1·44
Chlorine,	= 3·78
Nitric acid (N_2O_5),	= 2·59
Oxidizable organic matter,	= 0·04
Free and saline ammonia,	= 0·004
Ammonia as organic nitrogen,	= 0·002

Dr. Wallace, in his remarks, gave it as his opinion that these waters "contained nothing injurious to health—at least not immediately. They contain, however, evidence of a certain degree of pollution by animal products, although these are so completely oxidized as to be rendered harmless." He finally added, "these waters are fair representatives of good spring water." I consider that the opinion here given is not in keeping with the results of the analysis. That the water from the dip-well was grossly polluted by the products of sewage any one can see, so that it should have been condemned without hesitation.

Besides these wells, each of the farmhouses in the neighbourhood has one or more wells for its own water supply, and these have for the last eight years been more or less connected with the fever of the place. It will be necessary to give some particulars as to the situation of these wells and the quality of their water. The particulars of their surroundings I extract from a report prepared in December 1884 by a Committee of the Local Authority of Kilwinning for the Board of Supervision anent the water supply of those farms in the parish that were licensed to sell milk. To have made a complete chemical analysis of each well would have incurred serious expense, so that the Local Authority adopted the much cheaper method of describing only the position of the wells. This method is undoubtedly, in certain cases, quite sufficient to condemn the water.

Well at North Fergushill Farm.—"The open well is in a most suspicious position, and is supplied by a common tile drain running across Fergushill Square. The course of the drain is right below the principal privy and ashpit in Fergushill Square. About two years ago the water was so bad that the family were almost obliged to give it up. They were all affected with diarrhœa of the kind which generally accompanies fever." I may here remark that at this time there were no young persons living at the farm, for had there been, the illness referred to would in all probability have developed into genuine enteric fever, instead of aborting in the form of diarrhœa.

Well at South Fergushill Farm.—"The well is in the courtyard, and having been reported on unfavourably by a Glasgow analyst, the Committee resolve to send a sample to an Edinburgh Analyst." We cannot help smiling at this method of procedure by the Local

Authority, but it is one very commonly adopted everywhere—viz., to keep sending samples to different chemists until at last a favourable report is obtained. The unfavourable analysis referred to above was made by Dr. Clark, City Analyst for Glasgow, and is as follows :—

SOUTH FERGUSHILL FARM PUMP WELL.

(*Analysed 10th September, 1884.*)

	Grains per Gallon.
Total solids,	= 30·38
Volatile and organic matter,	= 6·77
Chlorine,	= 5·17
Nitric acid, (N_2O_5)	= 2·75
Oxygen consumed,	= 0·057
Free ammonia,	= 0·0016
Albumenoid ammonia,	= 0·0028

In his remarks on this water, Dr. Clark says :—"The results of my analysis show that this water is grossly contaminated with the products of sewage, and although these seem to be in an oxidized condition at present, such a large proportion of nitric acid indicates that the soil in the neighbourhood of the well is saturated with sewage matters, and the use of such a water is, in my opinion, attended with great danger." I have not been able to ascertain what kind of report the Committee obtained from Edinburgh.

Well at Windyhall Farm.—"The water supply is from an open well at some distance from the steading, and near the banks of the Lugton. The Committee recommend that a railing should be put up to prevent the droppings of cattle from materially injuring the water. A shallow ditch should also be made on slope near well to take surface water past mouth of well." As this farm will again come before us, I may here remark that there was another well much nearer the house about which the Committee did not report. Probably their attention had not been drawn to it by the farmer, but which, as will appear later, is most grossly contaminated.

Well at Burrowland.—"There is a well in close beside dunghill; said not to be used in any way which would cause danger. The domestic supply is got from a well several hundred yards distant from the house, and in a situation where sewage contamination is impossible." Of course, the Committee received no guarantee that the well in "close beside the dunghill" would not be used by careless servants nor in needy times. The farmer himself told me that the water drawn from this well was sometimes like "cow wash."

Having thus explained, as shortly as possible, the position, conditions, and surroundings of the wells of the two villages and the immediate farmhouses, we are now prepared to understand what follows. In the month of January, 1883, the farmer who was residing at Bensley farm scattered Glasgow manure over the field at Bensley village, in which was the spring that supplied the villagers

with water. He also emptied a large quantity of Glasgow manure into a heap close beside the well. This was done during a time of hard frost, but soon thereafter the rains came on, the burns overflowed their banks, and completely flooded the manure heap, so that for the next twenty-four hours there was no access to the well, which was found afterwards to be completely spoiled by soakage from the manure. The housewives of the place were in high dudgeon, and, as they could get water nowhere else, they marched in gangs to Bensley farm, and drew water from the pump there. Gradually, however, they tired of the distance, and as the water at the village well was resuming its usual colour and taste, the pump was again brought into use, with the result that in the first week of April a severe attack of enteric fever commenced at Bensley, which by and bye spread to Fergushill and the surrounding farmhouses. The cause and effect were so well marked that everybody blamed the Glasgow manure.

During 1883, and on until September of 1884, taking into count not only the genuine cases, but also those of a febrile nature which aborted, I stated to Dr. Russell of Glasgow that I must have dealt with at least a hundred cases. In 1883 four of my patients died, and in November of that year I had 15 cases lying ill at one time. Many of my patients were children, which circumstance, in my opinion, accounted for the low mortality, as children die hard when struck down with enteric fever. This attack not only caused deaths, but it lowered the general health of the place, and to a certain extent it demoralized the people, because when fever left a house it left the family much poorer, sometimes pauperized. It left one family fatherless and another motherless; some it left with scars, and some otherwise permanently weakened.

In August of 1884 the circle which surrounded the infected area began to widen, and it did so in this wise. A man named Crown, aged 51, residing at Fergushill Rows, had a slight attack of the fever. His daughter, aged 16, was serving at the farm of South Fergushill. She was allowed to visit her father. On the 1st September, 1884, she sickened at the farmhouse. In a few days after this date, as soon as I recognized genuine enteric, I caused her to be removed to her father's house at Fergushill, as she would not submit to be removed to the hospital. This girl subsequently died. From this farm milk was sent to Glasgow, and there infected 104 individuals in the Western, Royal, and Belvidere hospitals, causing nine deaths. The poisoned milk was traced to its source by Dr. Russell, who opened fire upon the guardians of the public health of Kilwinning. This war, commenced by Dr. Russell, was fought out in the local newspapers between sanitary officials and others, and lasted over a period of several months. As is usual in such cases, everyone in charge considered some other body more guilty of the sins of omission than himself.

The points brought prominently to the front in this paper war were these—(1) that South Fergushill farm had a polluted water supply, and that this polluted water, through milk, had poisoned several people in Glasgow; (2) that fever began, as already stated, at Bensley, spread from there to Fergushill, and that the water supply of Fergushill village was grossly polluted, for Dr. Russell caused the water of the open dip-well to be analysed by Dr. Clark of Glasgow, who found the following amongst other ingredients :—

FERGUSHILL VILLAGE DIP-WELL.

(*Analysed 10th September, 1884.*)

	Grains per Gallon.
Total solids,	= 30·14
Volatile and organic matter,	= 4·32
Chlorine,	= 4·27
Nitric acid (N_2O_5),	= 2·31
Oxygen consumed,	= 0·185
Free ammonia,	= 0·0098
Albumenoid ammonia,	= 0·0042

In his remarks, Dr. Clark says :—"This water is grossly contaminated with the products of sewage matter, and its composition is similar to what would be obtained by filtering a mixture of one part of Glasgow sewage and four parts of pure water through a porous soil. In my opinion the use of this water for dietetic purposes is attended with great danger." Dr. Wallace should have given a similar opinion on 19th October, 1877, for the water was almost as filthy then as now.

Although I have given a rather meagre account of this epidemic, still I think I have said enough to justify us in considering it proved that the typhoid bacillus was brought to Bensley and Fergushill in Glasgow manure, where it took the lives of five individuals and lowered the health of two villages, and that it was returned to Glasgow through the milk of South Fergushill farm, where it again took the lives of nine other persons.

The opinion of Dr. Clark regarding the quality of the South Fergushill farm water, and that of Fergushill dip-well, was expressed in language sufficiently plain to be understood by and arouse everybody. What, then, was the result? The farmer's well was ordered to be shut up, and he was provided with a rain-tank, so that he now uses water from the slates. The proprietors of the colliery had no conception that the dip-well at Fergushill or the pump-well at Bensley was polluted, as they were depending on the favourable opinion given regarding these waters by Dr. Wallace, on 19th October, 1877, when he said "they were fair representatives of good spring water." They, however, with commendable zeal, at once set about repairing the water supply of the two villages. They sunk a well 15 feet deep at Bensley spring, and got what they considered a plentiful supply of water. An analysis of it was made, and considered satisfactory

by the Local Authority of Kilwinning. This water was then led to Bensley, a distance of about 150 yards, and to Fergushill, a distance of about 650 yards. Pumps were fitted up at each of the places, so that I was able to certify to the proprietors that the villagers had a plentiful supply of wholesome water. The Fergushill women, however, began by and bye to complain very much about the difficulty they had in pumping the water, which the tradesman who fitted up the pump said "was due to the friction of the water in the pipes." I have gone somewhat fully into these minutiæ because much of what follows hinges on these seemingly trifling details.

At this juncture a troublesome complication arose. Although no analysis was made of the water at North Fergushill farm, the well was nevertheless ordered by the Local Authority of Kilwinning to be shut up, as it was fed from the same spring as the dip-well of the village. I have already given, concerning this North Fergushill well, the statements made by the Committee of the Local Authority—viz., that "the course of the drain by which it is fed is right below the principal privy and ashpit in Fergushill Square." The farmer, however, had discovered the spring about forty years ago, dug the well, and used it before it was polluted, or at least before houses were built around it, and as the excreta of the colliery encampment had spoiled his water supply, he very naturally claimed compensation. The colliery proprietors, in order to satisfy his wants, led a branch pipe from the main water supply of the village in to his farm, and fixed up a pump, so that forthwith he was to use the same water as was supplied to the two villages. This was a fatal error, as will afterwards appear. At this point the paper war ceased, and, I am sorry to relate, the improvements of the farm wells also.

As to the media by which the fever spread during the epidemic, there can be no doubt that the chief source of the poison was the water originally polluted by the Glasgow manure. From the water the poison gained entrance to the milk, by which Glasgow was in turn again infected. Probably also some of the villagers were themselves infected through the milk. Besides the water and milk, there were other media of propagation, and one of these was treacle ale bottles. There were several manufacturers of treacle ale in the two villages. They sold this beverage at a halfpenny per bottle if the bottle were returned. Such bottles sometimes lay for days in fever-stricken houses. Some of these treacle ale manufacturers, who are mostly widows, act as midwives in simple cases, and one of them had a somewhat wider practice than the others. This one did duty as a sick-nurse when required, and acted as midwife at a farmhouse near Kilwinning, which lay at least a mile outside the infected area, and at another place, also nearly a mile outside the circle of infection, but on quite the other side of the circle. It is a singular circumstance that, after the epidemic had disappeared from the villages, this nurse was

called upon to do duty at both these places, and at both places the mothers took fever, one of whom died. There were no other farmhouses in the parish that I knew of that were infected besides these, nor did this nurse act at any other place. Her treacle ale cellar was beneath the bed. Another medium which I am convinced carried infection was potted head. This was also manufactured and sold in several houses, but largely in one house, where there were several cases of fever. Although I cannot in this outbreak prove this conviction, I may say that many years ago, at another colliery village, I traced the fever to its source in a shop where this was extensively sold.

On looking back through these seven or eight years, I consider that I am justified in saying that it was fortunate for Glasgow that milk was not sent there from North Fergushill farm during 1883 and 1884, as in all probability the Glasgow people would have been struck down sooner from this quarter, and might not have discovered so readily who struck the blow, for although there was no genuine enteric case, nor diseased cattle about the premises, still I consider that the milk from the cows of this farm at the time must have been infected from the well, and although not altogether carrying on, at least helping to carry on the guerilla warfare of the bacilli amongst the inhabitants of the village, as the source of the water which supplied the well was within a few feet of an ashpit, where all the excreta of a fever-stricken house were emptied, and where the father died of fever in June, 1884.

The inhabitants of Bensley and Fergushill are a very stationary people, from the fact that many of them are related by intermarriage, and because the colliery is a favourite one on account of the steady employment given; hence, it is seldom that newcomers obtain a footing in the villages. For some considerable time after this epidemic the coal industry was very dull, many of the men preferring to go abroad rather than settle at Scotch collieries. These circumstances, coupled with the fact that the inhabitants might also be considered fever-proof, threw the bacilli for a time out of employment. No doubt the improved water supply at the two villages was a most important factor in bringing the epidemic to an end, and above all the supply to North Fergushill farm; hence, it is not to be wondered at that in the early part of next year—viz., 1885, I had not at these villages any typical, nor could I say very suspicious, cases, but in September of that year a newcomer, a man who had served his time as a soldier in the reserves, entered Fergushill village. He sickened at the end of October, but was at work again in January following. About the end of January the man who worked at the same coal face with him sickened and developed a very bad attack of fever.

In March another newcomer was struck down at Bensley, but was at once removed to Kilmarnock Hospital, where he recovered. I was quite at sea with regard to the cause of these cases, but here I will state what I did not then know, but what I years

afterwards learned—viz., that as soon as the fever scare of 1883 and 1884 died down, there commenced a regular system of theftuously taking a forbidden commodity—viz., the water from the dip-well of North Fergushill farm, which I believed to be shut up, and which would have brought on the place, had there been material at hand, as great disaster as the previous epidemic. The well is so situated behind a hedge and thorn bushes, that it cannot be seen unless specially looked for.

During 1887 I had a clean sheet, but in October of 1888 a servant girl, who every fortnight visited her people at Fergushill, was struck down in a neighbouring farmhouse. Her brother, who was also a farm servant, and who made the same sort of visits to the place, was struck down the following July. One of these farms sent milk to Glasgow.

In the month of May, 1889, a young married couple, with an infant, came from Maybole to reside in the Rows. The husband belonged to the Fergushill neighbourhood, and may have been rendered fever-proof by having had a mild form of the fever at an earlier period of his life; that we could not ascertain. The wife, however, sickened with genuine enteric in August. She submitted to removal, so I had her sent to Kilmarnock Fever Hospital, where she ultimately did well. This woman stole freely of the forbidden article, as she afterwards confessed to me.

Here was another genuine case of fever occurring in the very centre of Fergushill village, a newcomer as usual being the victim. My first impulse led me to suspect our village water supply, but on analysis I found it above suspicion. The following are the results:—

Bensley and Fergushill (New Supply).

(*Analysed 24th September, 1889.*)	Grains per Gallon.
Total solids,	= 8·00
Matter driven off at red heat,	= 3·00
Chlorine,	= 1·10
Nitric acid,	None.
Nitrites,	None.
Free and saline ammonia,	None.
Iron,	Present.

In the face of so favourable an analysis I did not suspect North Fergushill farm, as it was supplied by the same water, and besides there was no sickness about the premises.

In the month of June of the following year—viz., 1890, another newcomer entered the place. This was a young wife from Ayr. Her husband belonged to Fergushill, and was, of course, fever-proof. She sickened in August, and was removed to Kilwinning Fever Hospital, where she ultimately did well. This woman, I also learned later, used the forbidden water.

Since I could find no fault with the water of the villages, I set myself to inquire into the milk supply in all fever and diarrhœal cases. There were six farmers selling milk to the colliers, and generally the one who came first had the greatest sale, so that no

one family, with few exceptions at least, was receiving a single farmer's milk. I, however, found the name of the farmer residing at North Fergushill most frequently mentioned, but considered this due to the fact that he lived nearest the villages, was soonest out in the morning, and sold all his milk there. I knew that his water supply was not contaminated, and that there was no illness in his family. In these circumstances he appeared blameless, so that my search in this direction ceased.

At the end of 1890 another newcomer entered Fergushill, this time a young man. Nothing happened to him during January or February of the following year, but in March he sickened and developed genuine enteric fever. He would not submit to removal. His excreta, in spite of all directions to the contrary, were thrown out into the common ashpit, and whilst he was lying with the fever the ashes, as I afterwards learned, were lifted and carted away by a young lad who was acting as servant boy to the farmer at Burrowland. In a fortnight afterwards this boy felt ill, gradually became worse, and at last I was asked to visit him. Although the boy sickened in somewhat the usual fashion, still for a few days I could not decidedly say that he had caught the fever of the place. My first thought, however, was about the dairy and the milk. On enquiry at the farmer, I found that he churned part of the milk and fed calves with the remainder. During the time that this case was doubtful the farmer got an order for milk from a Glasgow dealer. He asked my opinion on the matter. I advised him not to send it at present. In a few days more (the 14th of May) this boy was removed to Kilmarnock Hospital, suffering from typhoid fever, where he ultimately made a good recovery. I give this incident as an instance of how Glasgow might have been infected. This Burrowland farm is the one concerning which the Local Authority reports—"There is a well in close beside dunghill, said not to be used in any way which would cause danger, &c." But, in all justice, let it be known that, after the epidemic of 1883 and 1884, the proprietor of this farm very wisely, on the recommendation of the Local Authority of Kilwinning, built a new rain-water tank, which is now in use. I made an analysis of the water a few days after the boy's removal, and found the following:—

BURROWLAND FARM RAIN TANK.

(*Analysed 19th May, 1891.*)

	Grains per Gallon.
Total solids,	= 18·00
Matter driven off at red heat,	= 5·00
Chlorine,	= 1·90
Nitric Acid (N_2O_5),	= 0·80
Nitrites,	Very abundant.
Oxygen consumed in 3 hours,	= 0·084

The residue during incineration turned brown, and finally dirty white. It evolved a slightly disagreeable odour.

The excessive total solids are partly accounted for by the fact that lime was lately put into the tank, but the large amount of matter driven off at a red heat points to filth; still, from what I know about the quality of the rain-water of the district, I am not prepared to say that the above analysis indicates farm sewage contamination, although these figures, especially when the position of the well is taken into consideration, arouse one's suspicion, because the large hole into which the rain-water is led is built of brick, cemented, and situated to the dip of the outhouses. The underground pipes which carry the water are made of fireclay and cemented with Arden lime at the joints. They pass close to the privy and a large cesspool into which all the wash from the piggery is led. If the joints are not thoroughly luted, the water may be polluted by sewage at any time, and this I pointed out to the farmer when arguing how necessary it was to remove the boy, as a single case of fever in such circumstances might contaminate the water for an indefinite period of time.

During the summer of 1890 we had several suspicious diarrhœal cases amongst children at Bensley. The excreta, of course, found their way to the ordinary ashpits, which were cleaned by the farmer who resided at Windyhall, and scattered on a grass field behind his house right above the well, around which the Local Authority in 1884 had recommended "a railing to be put up and a shallow ditch to be made on the slope to take surface water past the mouth of the well." That surface washings can easily get into this well is proved by the fact that railway sleepers dipped in creasote on one occasion were laid down about 100 yards from the well. The farmer's wife told me that in a short time afterwards the water tasted so strongly of creasote that its use was temporarily abandoned.

In the month of December, 1890, a genuine case of enteric occurred at Bensley village. The child was only 3 years of age, and thus escaped the epidemic of 1883 and 1884. The family to which this child belonged were receiving their milk from North Fergushill farm. In two months afterwards another young girl, 8 years of age, living next door also took the fever. The excreta were thrown out into the ordinary ashpit, carted away by the Windyhall farmer, and scattered on the fields by his daughters. The farmer himself early in February began to plough down the ashes which lay in the field above the wells. On the 16th of the month one of the daughters, aged 14, sickened and developed unmistakable typhoid. The parents would not permit the girl to be removed. The mother was determined to nurse the patient, and promised to keep her isolated in one end of the house. This was easily done, as the house was fortunately constructed to allow of it. In a few days, however, the fear of the fever and the strict attention to cleanliness and isolation ceased, with the

result that in due course another daughter and the mother herself were stricken. No removals were allowed. The two girls recovered, but the mother died early in May.

I have no doubt whatever that in this case the enteric bacilli were carried from Bensley Rows to the fields by the farmer, where they may have attacked the first daughter in much the same way as they did the servant boy from Burrowland, whilst working among the ashes. However this may be, I felt more inclined to blame the soakage from the ashes in the newly ploughed field which lay immediately above the wells. I have already said that at this farmhouse there were two wells, one much nearer the house, the dunghill, and field on which the ashes were scattered than the other, and very dirty indeed, but said only to be used for washing purposes and the cattle about the farm; still, I am compelled to say that its proximity to the house must have been a strong temptation in cases of immediate want of water for dietetic purposes.

I made an analysis of this water, and found the following:—

Windyhall Farm Dip-well (Nearest House).

(*Analysed 7th May, 1891.*)

	Grains per Gallon.
Total solids, dried at 212° F.,	= 30·00
Matter driven off at red heat,	= 12·00
Chlorine,	= 3·50
Nitric acid (N_2O_5),	= 4·58
Nitrites,	Very abundant.
Phosphoric acid (P_2O_5)	= 0·63

The residue during incineration evolved the smell of burnt horn.

The above results show that the well is horribly polluted with the products of sewage. I also made an analysis of the other well, which is about 200 yards from the house. The results are given below:—

Windyhall Farm Dip-well (Farthest from House).

(*Analysed 7th May, 1891.*)

	Grains per Gallon.
Total solids,	= 28·00
Matter driven off at red heat,	= 10·00
Chlorine,	= 1·80
Nitric Acid (N_2O_5),	= 0·99
Nitritis,	None.
Oxygen consumed in 3 hours,	= 0·10
Free ammonia,	None.

During incineration the residue evolved the smell of burning straw, first burning black and finally brown.

Although creasote from the railway sleepers got into this well, and very likely enteric germs from the field above it, on which the ashes were scattered, still I think from the above analysis most

chemists who did not know all the outs and ins of the case would give a favourable opinion of this water, especially if they were told that it was 200 yards from the farm. Knowing as I do all the circumstances, I regard the use of it with grave suspicion. This is the well around which the Local Authority of Kilwinning advised "a railing to be put up to prevent the droppings of cattle from materially injuring the water."

On the 12th of May, whilst the poor mother at Windyhall was dying, there appeared another case of enteric fever at Seven Acres Cottage, half a mile beyond Windyhall. This time the father of a large family was stricken. I stated the dangers he incurred by persisting in remaining and being treated at home. Ultimately he consented to be removed, and was taken to Kilwinning Fever Hospital, where he did well. This man's wife, who would have been his only nurse had he remained, and who was his nurse during the few days he lay at home, was milking cows night and morning at a farm which sends its milk into Glasgow. I made an analysis of the water used by this family, and found the following:—

SEVEN ACRES COTTAGE DRAW WELL.

(*Analysed 15th May, 1891.*)

	Grains Per Gallon.
Total solids,	= 29·00
Matter driven off at red heat,	= 8·50
Chlorine,	= 3·50
Nitric acid,	None.
Nitrites,	None.
Oxygen consumed in 3 hours,	= 0·098
Frec ammonia,	= 0·0081

During incineration the residue turned black, and evolved a disagreeable smell.

The above analysis points to pollution by sewage or its equivalent before oxidation has taken place, and shows how very dangerous it would be to nurse a typhoid case on the premises. The position of the well at once aroused my suspicion, as it was close behind the house, where it could act as an effectual cesspool, so that the most casual observer could see that the family must be drinking of their own impurities. These facts, however, did not lead me to blame the well for anything else than perhaps impure water poisoning—certainly not for fever, as I never knew of a case of it at this house, and although the water was polluted, still I cannot say that there was any reason to think that the typhoid bacillus had as yet obtained a footing in this well. It may or it may not, still I feel at a loss how to account for this case. The patient may have drunk from the polluted wells at Windyhall, as a near cut road to his work lay past them. He did not remember having done so. As a proof that I formed a correct diagnosis of the quality of the

Seven Acres Cottage water, I have to relate the following:— About the end of June or beginning of July, a somewhat favourable report of this well was obtained from a practical analytical chemist, and as water was very scarce in the neighbourhood, a rush was made to the well. I was rather astonished at this report, as I had forbidden the family to use the water for some time after the fever had visited the place, and meanwhile clean out the well, which was not done. I consequently made another analysis after a heavy day's rain, and found that the chlorine had increased from 3·5 to 5·4 grains per gallon, and that the nitrites, which before were absent, were now markedly present; no fever, however, resulted from the use of this water. In about a fortnight after the death of the mother at Windyhall, there appeared a case at High Row, Fergushill, situated about 120 yards from the farm. This time a young man, 17 years of age, was the victim. He submitted to be removed to Kilwinning Fever Hospital, where three days afterwards he died. I have no doubt but that this case was infected from the farm, as the young man's mother did the washings there, and the cleaning of the house. Besides her wages she received as much milk as she chose to carry away for nothing, as it was forbidden to be sold from this farm.

Immediately after the death of the young man another case appeared, but this time a child—and where? At North Fergushill farm! The son had married since the 1884 epidemic, and now there were young persons on the premises. I was not perfectly sure of my diagnosis for about a week, but then it was confirmed by the mother sickening and developing undoubted enteric fever, whilst the grandmother also showed obscure symptoms. I now informed the husband that he would require to stop selling milk in the villages. At this juncture I again began to suspect that the water supply to Fergushill and Bensley villages, and North Fergushill farm was not above suspicion, so I made another analysis, with the following results:—

Bensley and Fergushill (New Supply).

(*Analysed 3rd June, 1891.*)

	Grains per Gallon.
Total solids, dried at 212° F.,	= 9·50
Matter driven off at red heat,	= 3·00
Chlorine,	= 1·30
Nitric acid (N_2O_5),	= 0·06
Nitrites,	Trace.
Oxygen consumed in three hours,	= 0·03
Free ammonia,	= 0·002
Iron,	Present.

During incineration the residue turned brown. There was no smell of burning organic matter.

This analysis showed that the constituents had somewhat changed since my former analysis, and as I am always jealous

of nitrites, even in traces when enteric fever is about, I felt inclined to blame this water. I learned, however, that in this point I was wrong, for on asking the farmer how his pump was working, he told me, to my utter amazement, that for the last three or four years it had been entirely stopped, and that he was now using the old dip-well that had been ordered by the local authority in 1884 to be shut up, because the course of the drain which fed it was right below the principal privy and ashpit in Fergushill Square. I at once prayed the farmer to desist from the use of this well, and also the villagers to take no milk from him until he got a proper water supply. In a few days more the farmer himself also sickened, and developed genuine enteric fever. I made an analysis of this dip-well, and found the following ingredients :—

NORTH FERGUSHILL FARM DIP-WELL.

(*Analysed 5th June, 1891.*)

	Grains per Gallon.
Total solids,	= 27·00
Matter driven off at red heat,	= 10·00
Chlorine,	= 2·40
Nitric acid (N_2O_5),	= 2·18
Nitrites,	Abundant.
Oxygen consumed in three hours,	= 0·05
Free ammonia,	= 0·002
Albumenoid ammonia,.	= 0·002

During incineration the residue became black, and evolved the smell of burning straw.

I also applied to this water the biological test, and found it to contain 200,000 micro-organisms per litre, or nearly thirty times the number generally found in Loch Katrine water. The above results show that the water is polluted with sewage material. The farmer's wife told me that about Christmas time the water was nearly white as milk, probably due to enormous numbers of a large white bacillus found in it.

On further enquiry I found that the farmer had abandoned the use of his pump, as it did not work well, and not at all when the Fergushill villagers were drawing water. The pump at Fergushill village was also so difficult to work, evidently owing to air getting into the pipes by the North Fergushill farm pump, that many of the women abandoned it, and even went the length of stealing water from the polluted well at the farm during the night—some of them rising as early as three o'clock in the morning to do so. I found out that all the newcomers who used this well water took the fever of the place.

I now put the sanitary officials of the county on what I considered the correct track, and asked them to take up the matter. There is no doubt, however, that the Glasgow enteric germs laid down at Bensley well in 1883 are still in the soil surrounding

these colliery villages, and seem to have undergone no attenuation by cultivation in our media during the last eight years.

Taking a retrospective view of these fever cases extending through all these years, two or three points of importance come prominently forward. The first one is the length of time which enteric fever has existed in the place, becoming, as it were, an established guest. Within one month in Glasgow during 1884, probably as many cases occurred there, infected by South Fergushill milk, as happened here during a period of eight years. How is this circumstance to be accounted for? The only explanation I can give is one which I have casually referred to already—viz., that Glasgow was infected by the milk medium, whereas the fever here was propagated principally, though not altogether, through the water medium; hence, we may infer that the virus in milk is much more powerful, or the bacilli more numerous, than in water. In point of fact, the newcomers here had sometimes to live two or three months in the place before they were struck down. I have no doubt that infected milk was sold again and again in Fergushill and Bensley during the last eight years, but the different effects produced from those in Glasgow are due to the fact that the milk was sold and consumed here before the bacilli, which got into it from the water, had sufficient time to multiply to that extent necessary to overcome a healthy individual.

Another point which strikes one is how much Glasgow and other towns lie at the mercy of the country farmers in so far as fever is concerned. There can be no doubt that Glasgow was infected by milk from South Fergushill farm during 1884, and the narrative given above shows that during the course of the fever here she has had more than one narrow escape.

Another point still comes strongly to the front—viz., the quality of the water of the district. A careful analysis of the wells in each case has been given, and although short, I consider it sufficiently detailed for sanitary purposes. On reading the results, one naturally asks, Do such analyses as these give us any assistance in ferreting out the whereabouts of the bacilli? I think they do. I myself, in gauging the quality of a water, depend very much upon the amount of chlorine, nitrates, and the presence of nitrites, never leaving out of sight the position of the well and the presenee, or absence, of disease on the premises. It may seem superfluous, but I cannot help saying that the position of the well, if suspicious, should cause a medical officer of health to forbid the use of the water, even although an analytical chemist should give it, as his opinion, "that the water was a fair representative of good spring water." Careful ehemical analyses, such as I have given, not only show us whether sewage, or its equivalent, can reach the well where we may expect the bacillus to be if fever be about, but also the ehemical changes which the impurity itself has undergone in reaching the well. This

chemical information is certainly very valuable in a parish such as ours, where the wells are shallow, and where much Glasgow manure is used. I am of opinion that the presence of nitrites should cause the well to be condemned out and out, whether fever be about or not, and that the presence of nitrates should be regarded as a warning note of danger. As corroborative of what I say in this respect, seven years ago Dr. Russell, of Glasgow, on enquiring about the epidemic of 1884, wrote me thus:—"I wish to ask your experience as a practitioner; can you give me some idea of the number of fever cases you have seen, and your opinion as to their causes?" I at once replied, giving him the number, and stated that he would find the *fons et origo* in certain wells. One of these was analysed, and gave results which allowed of no doubt but that the inhabitants were drinking one another. We all admit that the fever germ multiplies readily in milk, by means of which it can easily, in some cases at least, be traced to its origin; but city manure, farmhouse manure, and shallow wells are important factors in its origin and propagation, and should never be lost sight of by the medical officer of health. A wholesome supply of pure water from "fairly outside the camp" is urgently needed, and I hope the day is not far distant when no farmer will be allowed to sell milk who has not an abundant supply of pure water at hand.

In concluding, I will repeat, and it cannot be repeated too often, what Professor Gairdner said 30 years ago, when lecturing on impure water in connection with cholera—"Pure water in every house, pure water at every man's hand, pure water in such abundance, and so accessible as to make the domestic use of impure water simply impossible, are the safeguards, the only safeguards we know, against the greatest of modern pestilences." These words are equally true when typhoid fever is the pestilence.

EPIDEMIC HOSPITALS AND THEIR CONSTRUCTION.

By WILLIAM MACKENZIE, Esq., M.S.A., Architect,
County Sanitary Inspector, Dingwall, Ross-shire.

Mr. President and Gentlemen,—The adoption of the Infectious Diseases (Notification) Act, 1889, makes it inevitable that the question of proper hospital accommodation must very soon engage the serious attention of all Local Authorities throughout the country. The present supply is so inadequate to the demand, and the distance required to travel over before reaching them is often so very great, that in quite a number of country districts it has been found impossible to take advantage of them as a satisfactory means of coping with the exigencies of infectious outbreaks. At present, for instance, in the County of Ross and Cromarty, we have only two such institutions, with combined accommodation for 20 patients, to meet the requirements of a population of 77,000, living over an area of 3,130 square miles, which embraces districts having no roads or other means of rapid and safe conveyance. One of them is situated in the county town, and contains 8 beds. It is the only one we possess to meet the requirements of a population of 50,000, comprising the whole mainland portion of the county, with its area of 2,447 square miles. The other is at Stornoway, and contains 12 beds for the necessities of the entire island of Lews, with its population of 27,000 and area of 683 square miles. And not only so, but both of those institutions are of a general nature, intended to meet the needs of all kinds of disease, whether infectious or otherwise.

Now, gentlemen, if this county can be taken as a fair sample of the average accommodation throughout the counties, with respect to institutions of this nature, it stands to reason that until something be done, the intentions of this Act cannot satisfactorily be carried out, and public health officials will be forced to draw the attention of their respective authorities to the matter. In

doing so, they will no doubt find it somewhat difficult to get a number of them to move, on account of the optional nature of the 39th section of the Public Health Act which deals with such provision; but it seems to me that, by the time this Notification Act comes to be generally adopted, the necessity for increased accommodation will become so apparent that there will be no escape from facing it.

It will no doubt be argued that the isolation of patients suffering from infectious diseases can safely be accomplished within their own homes, that proper precautions can be there taken to ensure that such patients receive all due attention, and that the public health is in no danger from the spread of the infection; but, whatever may be said in favour of that contention with respect to districts having properly constructed and thoroughly sanitary dwellings and surroundings, it cannot, I venture to think, be maintained by any one in regard to districts containing a large percentage of the ordinary working-class dwellings, and much less respecting those comprising large communities of crofters. The housing of a very large proportion of this latter class is of the most wretched description, and presents no sanitary conditions whatever such as are really essential to the safe treatment of infectious disease. Not only so, but in those localities the inhabitants very often become so terror-stricken at the presence amongst them of a case of infection as renders it doubly difficult for the authorities to deal with it. In those circumstances, therefore, gentlemen, I see nothing for it but the stern duty of impressing upon our respective authorities the necessity for proper and adequate accommodation within our different districts. As we may, therefore, anticipate being called upon, sooner or later, to advise our authorities as to the most practical mode of dealing with the subject, it seemed to me that its ventilation at our present meeting might tend, at least, to bring out some general conclusions which cannot fail to be of service to us when the proper time comes.

The first question, then, which naturally arises is, What class of structure would be most suitable to recommend for adoption? Whether there should be comparatively large hospitals to serve correspondingly large areas, or a greater number of smaller ones, for smaller areas, and whether would they be more suitable if constructed of permanent rather than of more temporary material. Well, then, gentlemen, in reply to the first question, I have to confess a decided preference for comparatively small buildings to serve correspondingly small areas. I may mention, in passing, that the conclusions I have arrived at are come to from the standpoint of a sanitary inspector, as to what scheme would most satisfactorily enable him to carry out his distinctive duties under the Act. Possibly they may not be considered the most advantageous from a medical officer's point of view; but if not,

this will only evidence the more reason for a full and free discussion of the subject, so that we may arrive at some common understanding regarding it.

Well, then, as I have mentioned, I think we should, wherever practicable, recommend the erection of comparatively small buildings with accommodation for say not more than 10 to 12 patients of either sex, or considerably less even where found possible—always, of course, assuming that within a given district we can obtain a sufficient number of such institutions as will counterbalance the restricted accommodation. It must not, of course, be overlooked that whatever scheme is adopted there should be, generally speaking, in every district, provision for the reception of one patient for every 1,000 or thereabouts of the population. Small hospitals have the advantage of convenient organization. Their increased number will allow of their being erected within more prescribed areas, which will minimize the danger to patients in conveyance, particularly in rural districts, and also the greater risks of contagion in larger buildings, besides many other advantages which I need not wait to detail, as they are patent to all of us.

The other question which I referred to is, I fear, a much more debatable one. It is that of temporary *versus* permanent hospitals. In carefully studying a number of authorities on the question, and comparing the rate of mortality resulting from both kinds of structures with each other, I find that the result is considerably on the side of the temporary or hut idea, over that of solid permanent structures, and I fear I must therefore confess a preference for the former. On this subject M. Sarazin, one of the ablest authorities, remarks—"No more permanent hospitals—they must be replaced by wooden huts. The permanent hospital is the hospital sepulchre which nothing can keep wholesome, and which entails fabulous expenditure. The hut hospital, renewed in nearly all its parts every ten or fifteen years, alone presents the hygienic conditions necessary for hospitals, and admits of the realization of appreciable economics."

I am aware that the Board of Supervision in their practical suggestions do not look favourably on their introduction, nor do the majority of the profession to which I have the honour to belong; but still, looking at the question purely from a sanitary point of view, and judging it on the merit of results which I have examined, I fear I cannot do otherwise than suggest the adoption of the temporary structure as a building which can be constructed to present better hygienic conditions than can be obtained in the construction of one of a more permanent character. The Board of Supervision's objection to the idea seems to arise from the difficulty experienced in maintaining wards in such a building at an even temperature during all seasons of the year; but I do not think this need form any insurmountable difficulty, as any well

regulated system of heating and ventilation should be able to overcome this, or it is not worth the name.

The great objection to buildings erected of permanent materials is that, as they grow old, organic changes in the composition of their materials set in, and the structure becoming more or less deteriorated, presents most favourable conditions for the concealment of germs which exhibit such a tendency to adhere to all crevices and out of the way corners; whereas, on the other hand, if constructed of well seasoned and kyanized wood, they would need no extravagant outlay, and might only require to last say from twenty-five to thirty years, which would obviate the foregoing danger. Not only so, but if, as Dr. M'Vail so ably remarked yesterday, the sanitary conditions of dwellings be properly attended to hereafter, there may possibly be no longer any need for such institutions, which I think is as strong an argument as any in favour of temporary structures. Whatever idea, however, finds most favour in respect to material of construction, I think we will all agree that the building should not be planned with any other end in view than to meet the requirements of infectious diseases. There is no reason why they might not perhaps be utilized for other sicknesses when there are no infectious cases in the locality; but if so, it should be on the following conditions only, which I have taken from the footnotes to Section 39 already referred to, and which seem to me most essential:—"That no cases of ordinary sickness be admitted when the hospital is in use for infectious cases; that only such ordinary cases be admitted as could be easily removed as soon as the hospital is required for an infectious case, and that after the hospital has been in use for infectious cases it shall not be used for ordinary sick until the medical officer is satisfied that it can be used without risk."

Now, gentlemen, we have come to the matter of the practical details connected with the planning, and before proceeding we must have a definite understanding as to what constitutes a really healthy hospital; and for this purpose I shall content myself with reading you the definition submitted by Dr. Simon, medical officer to the Privy Council, which I venture to think is as satisfactory as can be given:—"A hospital which does not by any fault of its own aggravate ever so little the recovery of persons who are properly its inmates, and this the only right sense of the absolute word, governs the words comparative applications, so that when we compare them together with regard to their healthiness, and call one of them the unhealthier hospital, our meaning is that in this hospital, by means of some fault of its own, disease cannot be treated as successfully as in the other hospital; and the fault of its own, through which an unhealthy hospital fails to attain the best results from its medical or surgical treatment, is of two kinds—either it is an inherent fault, as of

site and construction; or else it is a fault of keeping, as dirtiness, or overcrowding, or neglect of ventilation."

This, then, is the character of building we shall have to produce, and in connection with it the first practical consideration must be given to the question of site. The first thing to make sure of is that an ample and perfectly pure supply of water can be conveniently obtained, and that there are proper facilities for good drainage. Then the site should be in a dry, open, and airy situation, with a gentle slope facing the south, and having a porous subsoil. No matter what the cubical contents of the wards may be, it is absolutely necessary that the situation be an open one, for, in the conclusions of the Surgical Society of Paris, nothing can compensate for the insufficiency or absence of natural aëration. The building should be in a position of easy access from all parts of the district it is intended to serve, should be some distance away from dwellings, not too close to a public road, and separated from the boundary fence by an interval of at least 40 feet. A site where gravel and sand forms the substratum would be infinitely preferable to one having clay or other impermeable material as its subsoil, and a hillside is, in most cases, more advantageous than a low-lying situation.

The buildings should be made as attractive as possible with due regard to economy, and should be so placed as to take full advantage of the sunshine, with the opposite side windows facing east or south-east and west or north-west. The conditions of the prevailing winds should be carefully studied, to avoid placing the buildings where they might be affected by such winds blowing over an unhealthy district.

The style of building which appears to be the most suitable is what is known as the Tollet system of single storied pavilions, and an adaptation of this system to local requirements would, I think, meet the needs of the subject in hand more satisfactorily than any other arrangement that might be suggested.

There is no reason why the administrative buildings, if necessary, might not be in two stories, but I think the wards will be infinitely better on the one level. This system seems to unite in the greatest degree the best sanitary conditions with the most moderate cost, and I think, therefore, requires no other recommendation.

In laying down the foundations, care should be taken that proper damp-proof courses of slates, felt, or other impermeable materials are never omitted; and, if the hospital be erected of timber, the walls should be raised sufficiently above the ground on dwarf walls of masonry. The several buildings should have a space of at least twice their own height to the eaves intervening between them. The arrangement of them would be somewhat as follows:—

First, we would have the two pavilions at opposite sides of the

building, for male and female wards, and running parallel with each other, having their sides facing respectively south-east and north-west, or as near to these directions as possible, and the administrative buildings between, communicating by means of covered passages. Each of these wards should have an annex at both ends—one end to contain an isolation ward of two beds, a dining-room, and lavatory; and the other, attendants' room, medicine room, linen closet, bath, water-closet, urinal, slop sink, and foul linen shoot—and the administrative buildings should comprise a kitchen, scullery, doctor's room, matron's room, and bedrooms for matron and cook. Besides these, outbuilding accommodation would be required for a wash-house and laundry, disinfecting room, ambulance shed, coal cellar, and water-closet for convalescent patients; also, a suitable mortuary, with ample ventilation at the roof and sides.

With regard to bed space within the wards, there is a divergence of opinion amongst authorities on the point, ranging from 1,300 to 2,500 cubic feet per bed. The Board of Supervision recommend from 1,500 to 2,000 cubic feet. Possibly the latter figure would be a pretty safe one to calculate on; and floor space from 90 to 150 superficial feet. Again, I should say the nearer the latter the better, or at least 120 superficial feet. There is a difference of opinion in regard to the lineal wall space for each bed ranging from 6 feet to 9 feet 9 inches. I should say 7 feet 6 inches would be a safe allowance. At any rate there should not on any account be less than 3 feet clear allowed between each bed.

The ceiling of the wards should be from 12 feet to 14 feet high, to run across at the level of side walls. In computing the cubical contents of wards, no account should be taken of any extra height over 24 feet.

The wards should have a window for every two beds extending in height from between 2 feet 6 inches to 3 feet 6 inches above the floor to within 1 foot of the ceiling, and they should be always double hung for ventilation. The proportion of daylight window space to ward should be about 1 square foot of window to between 50 and 70 cubic feet of space. The main ward should have a breadth of at least 20 feet.

The inside surface of ward walls should be plastered with some hard, non-absorbent material, such as polished Parian or Keen's cement, to a height of from 5 feet to 6 feet above the floor. The remainder might be plastered, but all should be painted with a thoroughly washable material or distempered in some cheerful tint which could be frequently renewed.

The wards should have all their re-entering angles rounded or bevelled off, and all salient ones suppressed to avoid as much as possible the risk of harbouring germs. They should never be provided with presses or cupboards for a similar reason. They

should not intercommunicate with each other, and ought to be always easy of access from the nurse's room, which should, indeed, have a communicating window.

The flooring of wards should be of well seasoned oak or pine, oiled and beeswaxed so as to avoid any necessity for frequent washing, which is liable to cause damp; and the walls of the sanitary apartments should be lined with enamelled bricks or tiles.

The best means of warming and ventilating are problems which require most careful consideration. The conditions to be secured are that the wards be at all times kept so as to vary as little as possible within a few degrees only of moderate temperature, and the air at the same time maintained in the utmost possible purity. To accomplish this I will quote an extract from Captain Galton's report on workhouse ventilation, which appears to me applicable to the present subject. He says:—"The principles laid down by the Commission appear to be those best calculated for workhouses, viz:—

"I. To keep each room independent of every other room in respect of ventilation.

"II. To depend for the ventilation upon the fire-places and upon the difference of temperature between the external air and the air within the rooms.

"These principles can be carried into effect as follows:—

"I. *Outlets for heated and impure air* should be provided by means of shafts carried up from the ceiling to above the roof, affording a sectional area of 1 inch to every 50 cubic feet of space in the room. These shafts should be placed, if possible, on the same side as the fire-places, but in the corners of the room furthest removed from the grates.

"II. *Inlets for fresh air.*—Means for the admission of air of the ordinary temperature should be provided direct from the outer air, independent of the windows and doors; for this purpose Sherringham's ventilators should be placed between the windows near the ceiling, affording a combined area of at least 1 square inch for every 100 cubic feet of space in the room, and openings of equal size should be placed close to the floor under the beds, but these latter should be capable of being easily and securely closed."

This latter system is sometimes arranged for by means of a perforated rounded skirting from 3 to 4 inches high.

The warming can be satisfactorily accomplished by means of a combination of open fire-place, and hot water pipes for the large wards with one fire-place for every twenty-five feet in length or thereabouts, and by open fires for the small wards. The apparatus known as the Thermydric grate, patented by Mr. Saxon Snell, architect, to whose combined work with Dr. Mouat on this subject I have to acknowledge my indebtedness for a number of the particulars in this paper, seems to answer the purpose

as well as anything of the kind in the market. This invention, in the words of the patentee, "consists of an open fire-grate surrounded on three sides and on top by a wrought iron chamber containing water, which when warmed by the fire circulates through upright coils of pipes placed on either side. The hearth is made of iron, and the whole space below the grate and pipes is formed into a chamber for the admission and collection of air from the outside. The outer fresh air thus admitted passes upwards, and impinging against the sides of the hot water chamber and pipes, becomes thoroughly heated without being burnt before entering the room. The obvious advantage possessed by this grate is that, unlike all other such inventions, the air cannot be burnt or heated above the temperature of boiling water, and the water contained in the vase being slightly warmed, it evaporates, and thus keeps the air of the room moist."

This apparatus can be so arranged as to stand in the centre of the wards, if desirable to economize space, in which case the smoke descends and runs in horizontal pipes beneath the floor, to enter a flue at the side. This channel is also made to serve the purposes of a duct, for fresh air to pass from the outside round the stove, and through the heated coils of pipes into the room. The sanitary chambers and their communicating lobbies should have separate cross ventilation by means of windows, and be so heated that the temperature will always stand higher there than in the adjoining wards, in order that the air may be rather drawn from the wards than to them.

As regards drainage, I shall content myself with merely quoting the practical suggestions of the Board of Supervision on the subject:—

"Where an efficient and well constructed system of drainage exists, the sewage of the hospital may be passed into the public sewers; but where a drainage system is wanting, or is of an inferior character, the discharges from the water-closets, sinks, and wash-house should be conducted to a cesspool within the grounds, properly constructed and suitably ventilated. The cesspool should be emptied every three months, and the contents dug into the soil, care being taken to avoid the hottest months for the operation. In no circumstances should the sewage from the hospital pass into an open ditch or field drain. All hospital drains must be constructed on the best principles, and supplied with efficient traps and means of ventilation."

In conclusion, I have only to add that this subject is of such importance in the present unsatisfactory housing in general of the classes of the population to which I have specially referred, as a factor in the stamping out of infectious disease, that I thought it fitting to bring forward, so that an opportunity might be given for its full discussion, to enable us to carry away some more definite information respecting it than we hitherto possessed.

APPENDIX.

ANNUAL MEETING AT EDINBURGH.

The Seventeenth Annual Congress of the Sanitary Association of Scotland was held in the County Chambers, Edinburgh, on the 23rd and 24th September—Dr. Farquharson, M.P., President of the Congress, in the chair.

Previous to the general meeting there was a meeting of the Council of the Association, and also the business meeting of the members of the Association, presided over by Peter Fyfe, Esq., sanitary inspector, Glasgow, President of the Association, when the office-bearers for the ensuing year were elected.

An invitation from the Provost and Magistrates of Aberdeen to hold the next Annual Congress at Aberdeen was cordially accepted.

The public proceedings of the Congress were thereafter formally opened by Dr. Farquharson, M.P., President of the Congress, who was introduced by Lord Provost Boyd, who also welcomed the Sanitary Association to Edinburgh.

Dr. Farquharson then delivered his address, as President of the Congress, on "A Model Hygienic State, or a Glance at the Sanitation of the Future."

At the close of the address, Bailie Russell, Edinburgh, asked the Congress to pass a vote of thanks to Dr. Farquharson for his able and interesting address, remarking that it was a very good thing for the country that there was in the House of Commons a man like him able to guide the House, and to help in devising machinery for putting into practice the science of hygiene, as he did in connection with the passing of the "Local Government (Scotland) Act," with its advanced compulsory clauses.

After the Presidential address, the members of the Association adjourned for luncheon, kindly supplied by the Corporation of Edinburgh.

On resuming after luncheon, Mr. Peter Fyfe, Chief Sanitary Inspector, Glasgow, President of the Association, delivered an address, choosing as his subject, "The Progress of Death in Scotland and her Counties since 1855: a Comparison." The address was illustrated by a large number of diagrams.

Dr. Joseph Coats, Lecturer on Pathology, Western Infirmary, Glasgow, read a paper on "Tuberculosis viewed as an Infectious Disease: its Prevalence, and the Frequency of Recovery from it."

A discussion on this paper followed, in which Dr. M'Vail, Medical Officer of Health, Stirling and Dumbartonshire; Dr. Eben. Duncan, Crosshill, Glasgow; Dr. Cluckie, Greenock; Professor Hay, Aberdeen, and others took part.

Dr. Eben. Duncan, Physician to the Victoria Infirmary, Glasgow, then read a paper on "Statistical Facts required in the Scottish Registrar-General's Mortality Tables, particularly with regard to Disease and Mortality in reference to Occupation," after which he moved the following resolution:—"That it be remitted to the Council to draw up a petition to the Secretary of State for Scotland, calling his attention to the need for greater detail in the Scottish Registrar-General's annual abstracts of mortality, and praying that he should draw up such rules for the management of the General Registry Office, and such rules for the preparation of the abstracts of mortality, as shall provide —First, for detailed tables of the causes of death in every separate district in Scotland; second, that a decennial abstract be published in which the causes of deaths relative to occupation shall be treated in detail, as this important subject is treated in the decennial supplements of the Registrar-General of England; third, that the deaths in general hospitals and fever hospitals shall be detailed separately, and allocated to the sanitary districts from which the persons of these institutions come."

Dr. Christie, Hillhead, Glasgow, seconded, and Dr. Hay, Aberdeen, supported—the latter gentleman holding that in regard to the matter Scotland was at a considerable disadvantage as compared with England.

Mr. Burns suggested that the Registrar-General be urged to issue his returns a little earlier than hitherto, and this met with Dr. Duncan's approval.

Dr. Naysmith said that the mortality among miners from phthisis was greater than among other tradesmen. He turned to the Registrar-General's abstract for information, but had found it quite impossible to obtain what he required, and it was not without great difficulty and expense that he got the information he wished. Shortly after he was appointed medical officer for Fife and Clackmannan, one of his first duties was to find what the death-rate of the county was, the mortality in the different parishes, and the different causes of diseases in certain death-rates. He got permission from the County Council to obtain the

necessary information from the local registrars, but out of about sixty-two registrars only about thirty agreed to send in these returns, so that he was at present in the position of not knowing anything of what the death-rate of the different parishes in Fife is, and it was absolutely impossible for him to supply statistical returns in the annual report which the Board of Supervision make it compulsory for him to do. He moved that the Association petition the Government, through the Secretary for Scotland and the Lord Advocate, in favour of obtaining a clause in the Registry Act for Scotland, as in England, making it compulsory for local registrars to forward mortality returns to local authorities.

Bailie Russell, Edinburgh, pointed out that from the terms of the Act, the Secretary for Scotland had apparently the power to make such regulations as would cover the case put by Dr. Naysmith. But they would be causing Lord Lothian to stultify himself if they were to ask him to make regulations which he had not the money to carry out, and this meeting should get up an agitation to provide him with funds.

The President said that no doubt the Secretary for Scotland had the power, and he did not think they should be at all backward in putting upon his Lordship any amount of responsibility, pecuniary or otherwise. But he agreed with Bailie Russell that the Secretary for Scotland should be backed up by public opinion. He suggested that the petition should be signed by himself, Mr. Fyfe, the Vice-President, and other officials, and should be sent to Lord Lothian without delay. When the estimates came up, Dr. Cameron and himself, and one or two others, would take the opportunity of saying something upon the question.

The motion was carried unanimously.

In the evening about seventy members of the Association dined together in the Waverley Hotel, under the presidency of Dr. Farquharson; Mr. Peter Fyfe and Dr. Eben. Duncan acted as croupiers.

On the 24th, the second day of the meeting, the attendance continued large, and the interest in the subjects discussed was unabated.

Prior to the general meeting there was an adjourned business meeting, when several resolutions were moved and carried.

Thereafter, Professor M'Fadyean, Veterinary College, Edinburgh, read a paper on "The Sanitary Control of Milk Supply for Cities;"

Mr. J. D. Watson, C.E., County Sanitary Inspector, Aberdeenshire, on "The Disposal of Village Sewage;"

Mr. A. M. Scott, Writer, Glasgow, on "The National Registration of Plumbers in its Relation to the Public Health;"

Dr. Milroy, Kilwinning, on "How Typhoid Fever Spreads.

A paper on "Epidemic Hospitals and their Construction," by Mr. W. Mackenzie, County Sanitary Inspector, Dingwall, Rossshire, was on the programme, but, on account of the lateness of the hour, it was held as read.

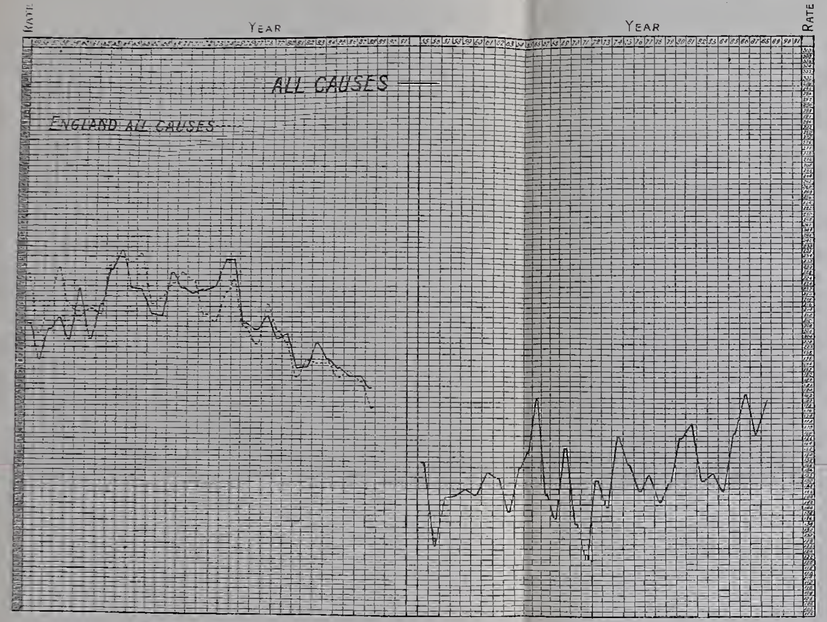
The meeting of the Association at Edinburgh was the largest and most successful which has been held, there being present a large number of medical officers of health, sanitary inspectors, and representatives of corporate bodies.

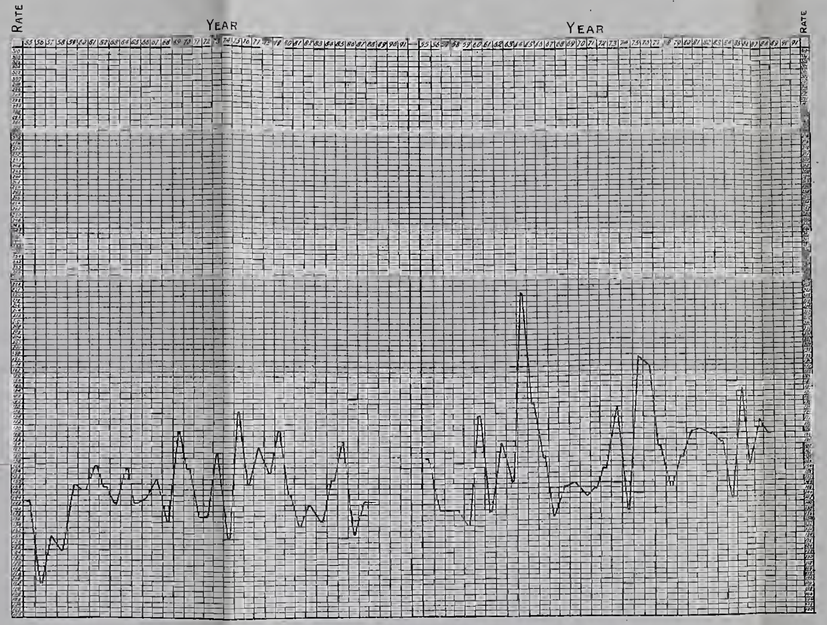
SECRETARY'S REPORT.

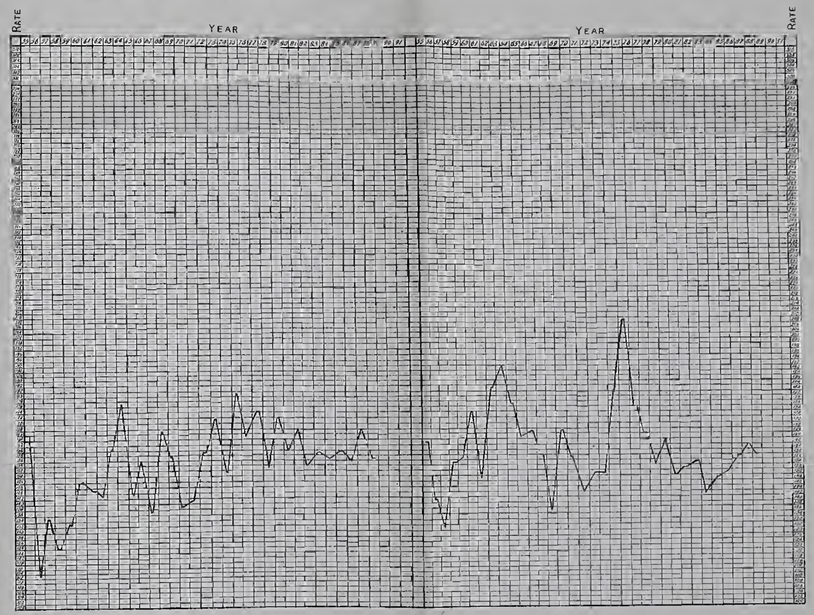
The Report of the Secretary (Mr. James C. Stobo, Rutherglen) stated that during the fourteen months which had elapsed since their last annual gathering, events of great national importance had transpired; every county in Scotland had been equipped with a staff of sanitary officials, the publication of whose work was beginning to open the eyes of the community to the great need of such an organisation. During the past fourteen months three examinations for the Association's certificate of competency had been held, and in the five examinations which had been held since January 1890, 52 of the candidates who had come forward had been certificated. After detailing the matters which had come under the notice of the Board of Examiners and of the Council in the course of the year, the report referred to the finances of the Association, and stated that while the income from all sources had amounted to £184, 16s. 8d., the expenditure had amounted to £94, 14s. 5d., leaving on hand a sum of £90, 2s. 3d.

The report was adopted.

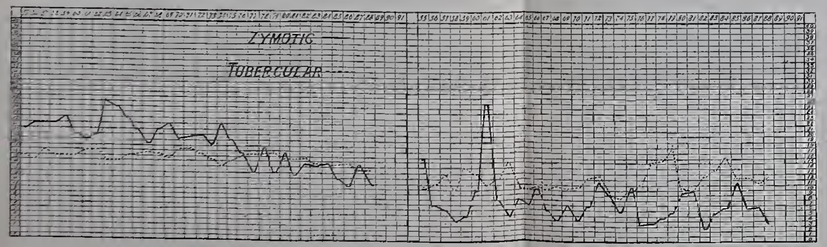
Series of Diagrams Showing the Death Rates from all Causes per 10.000 of the Population in Scotland and each of her Counties since 1855. and also the per centage of Zymotic and Tubercular Deaths to Total Deaths.







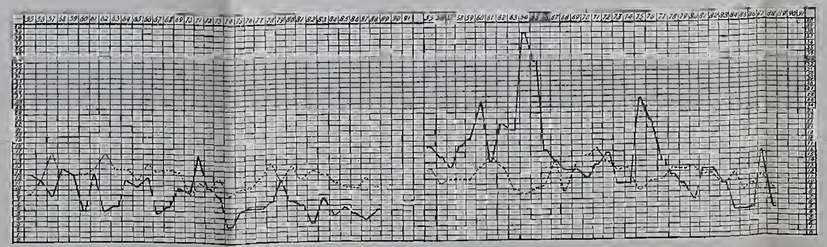
Scotland



Shetland

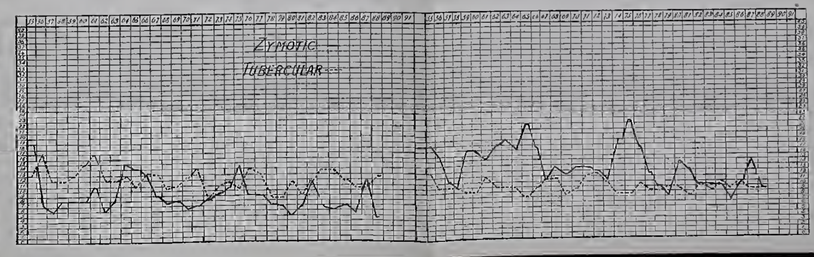
Orkney

Caithness

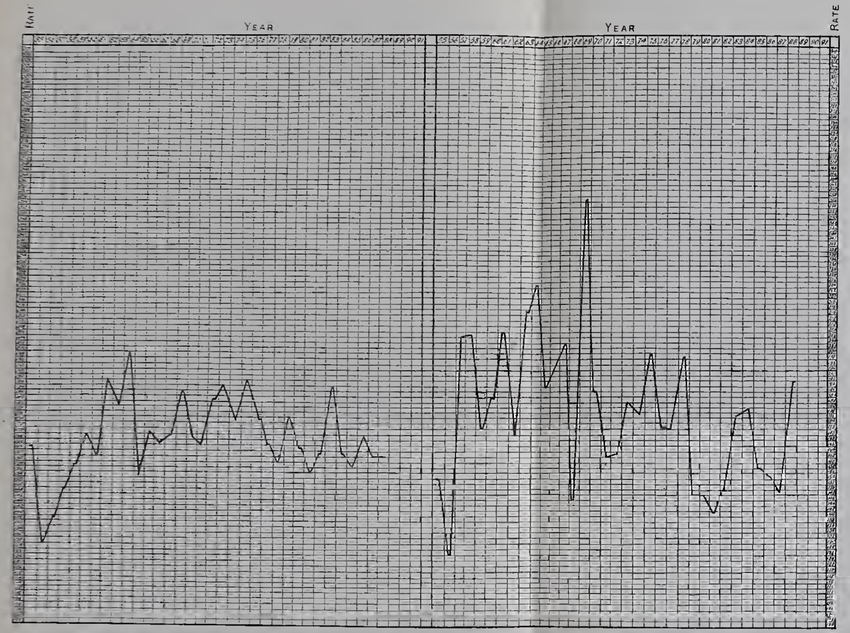


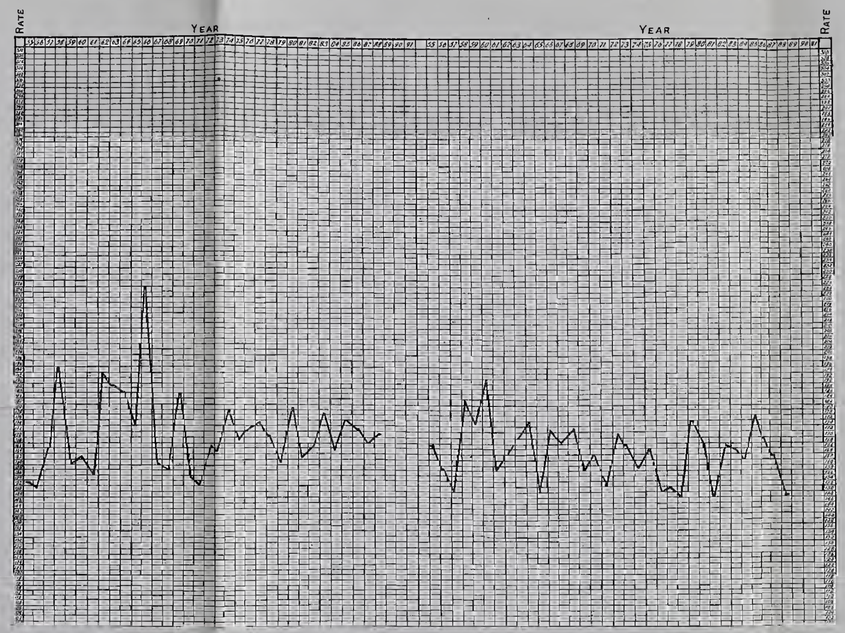
Sutherland

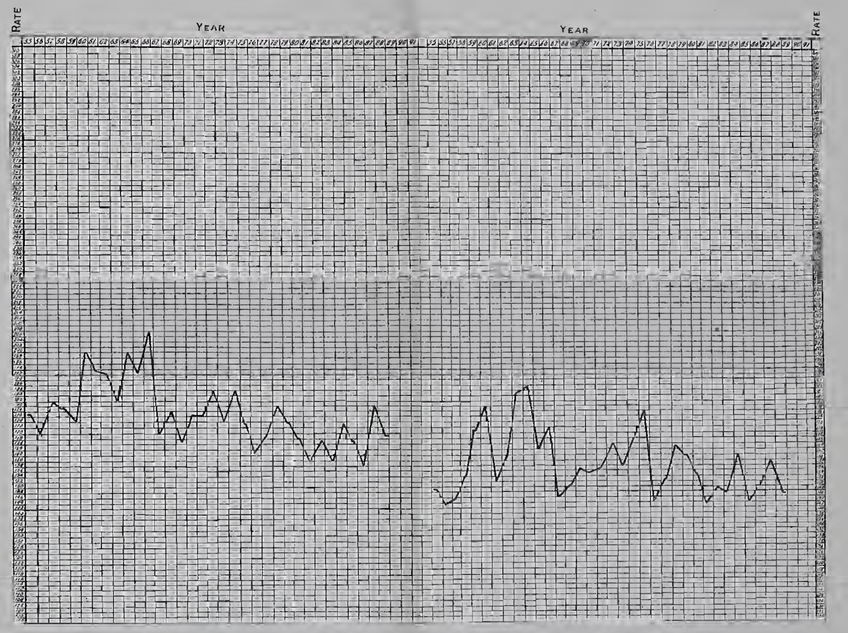
Ross and Cromarty



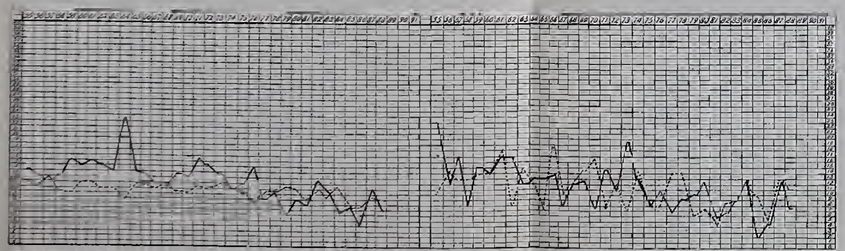
Series of Diagrams Showing the Death Rates from all Causes per 10.000 of the Population in Scotland and each of her Counties since 1855. and also the per centage of Zymotic and Tubercular Deaths to Total Deaths.



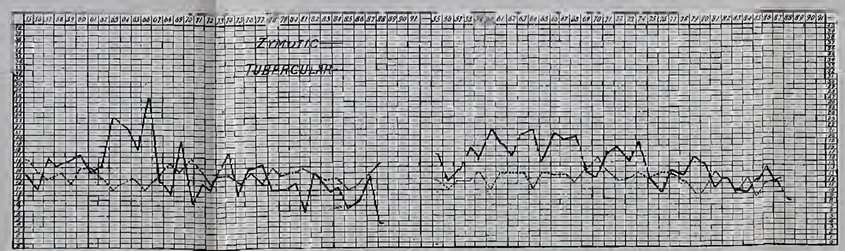




Inverness

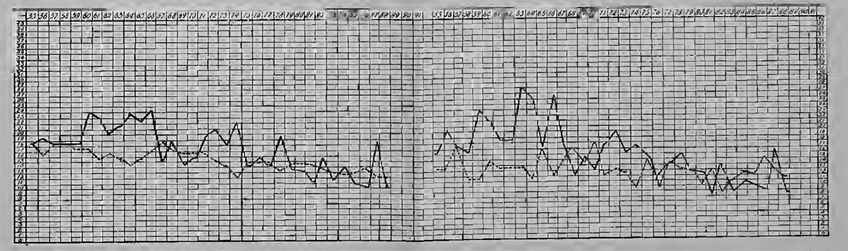


Nairn



Elgin

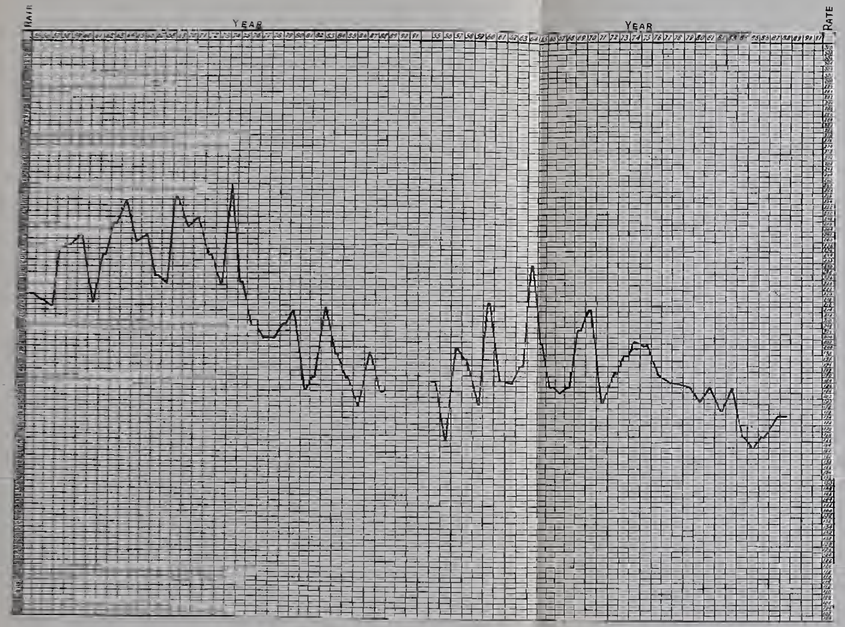
Banff



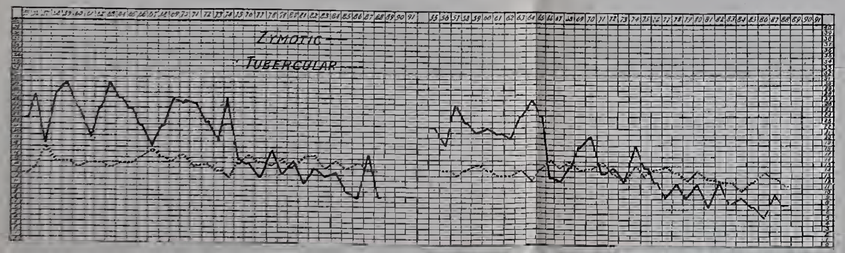
Aberdeen

Kincardine

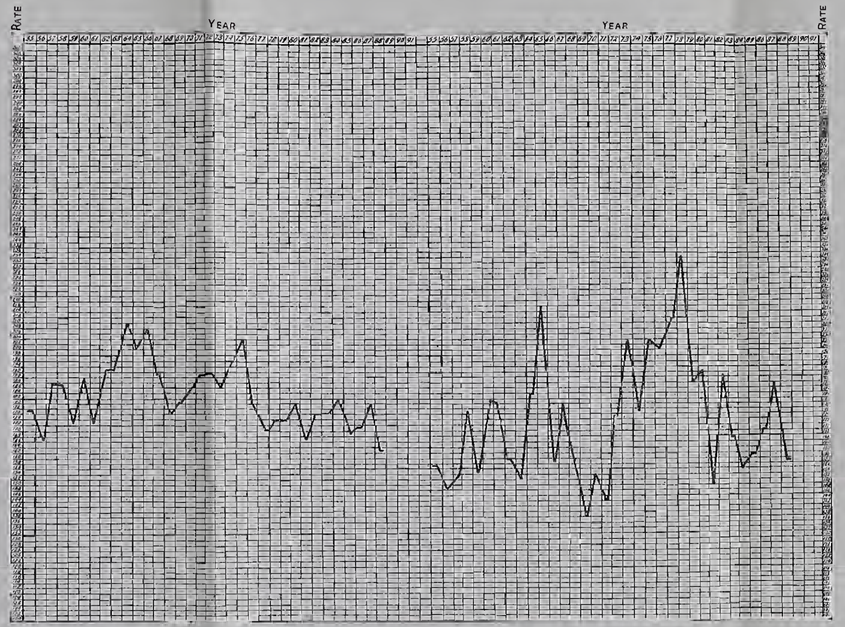
Series of Diagrams Showing the Death Rates from all Causes per 10000 of the Population in Scotland and each of her Counties since 1855. and also the per centage of Zymotic and Tubercular Deaths to Total Deaths.



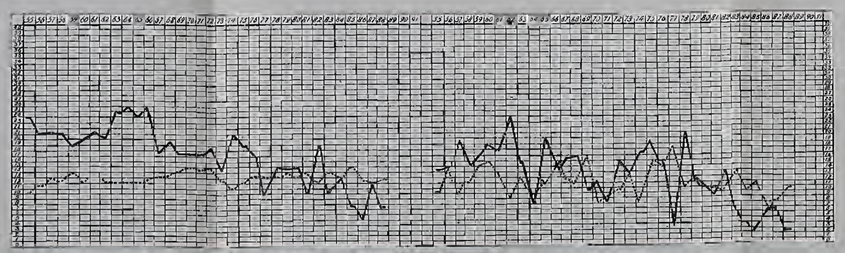
Forfar



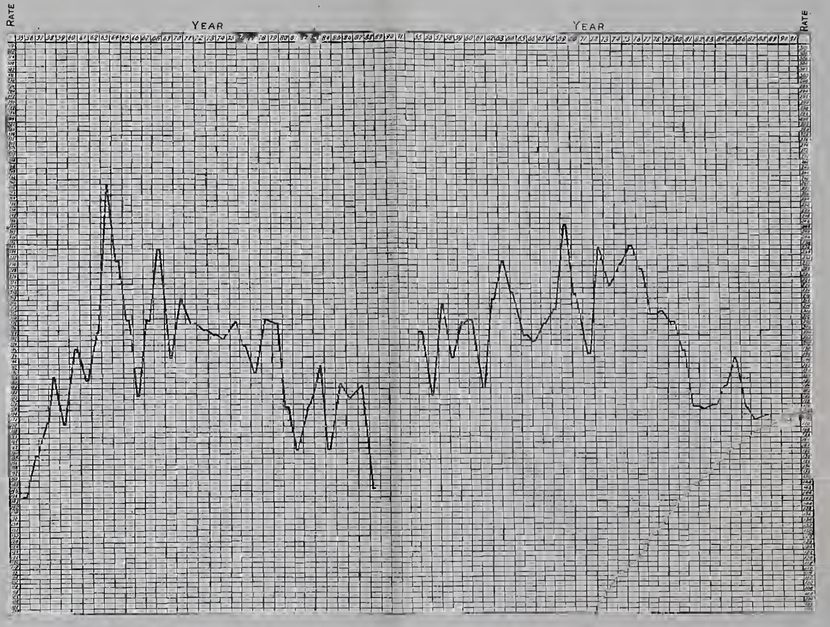
Perth



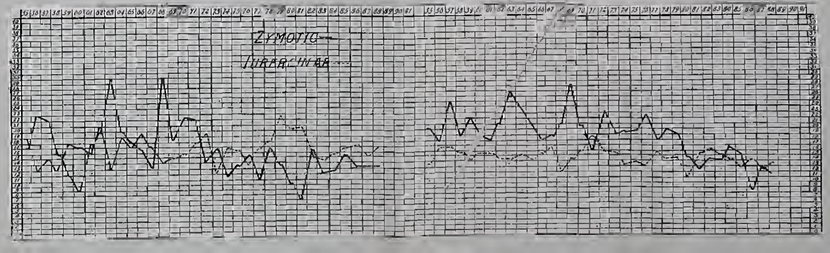
Fife



Kinross

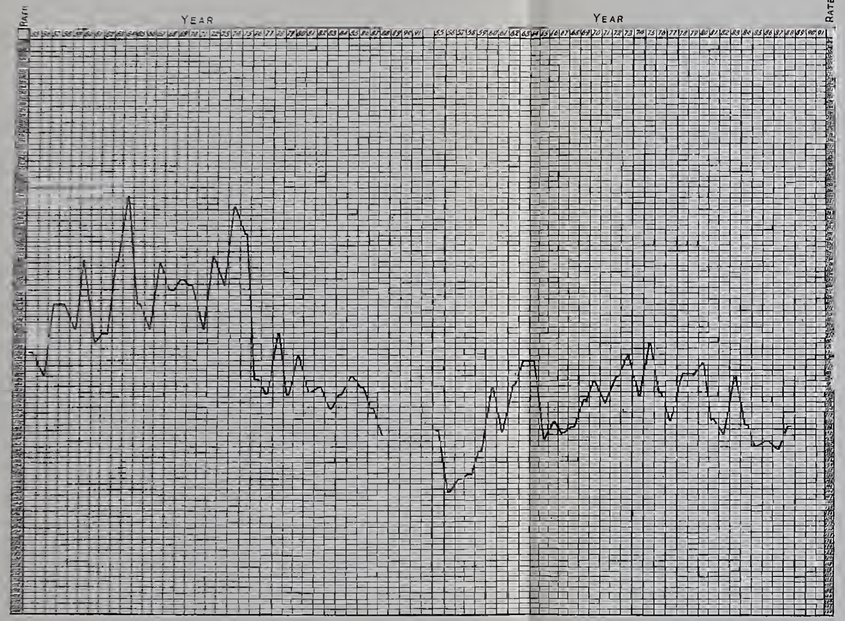


Clackmannan

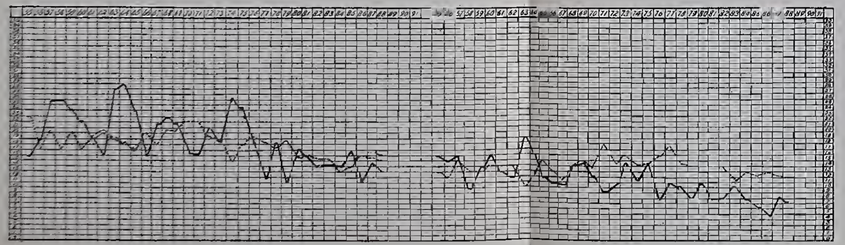


Stirling

SERIES OF DIAGRAMS SHOWING THE DEATH RATES FROM ALL CAUSES PER 10000 OF THE POPULATION IN SCOTLAND AND EACH OF HER COUNTIES SINCE 1855, AND ALSO THE PER CENTAGE OF ZYMOTIC AND TUBERCULAR DEATHS TO TOTAL DEATHS.



DUMBARTON



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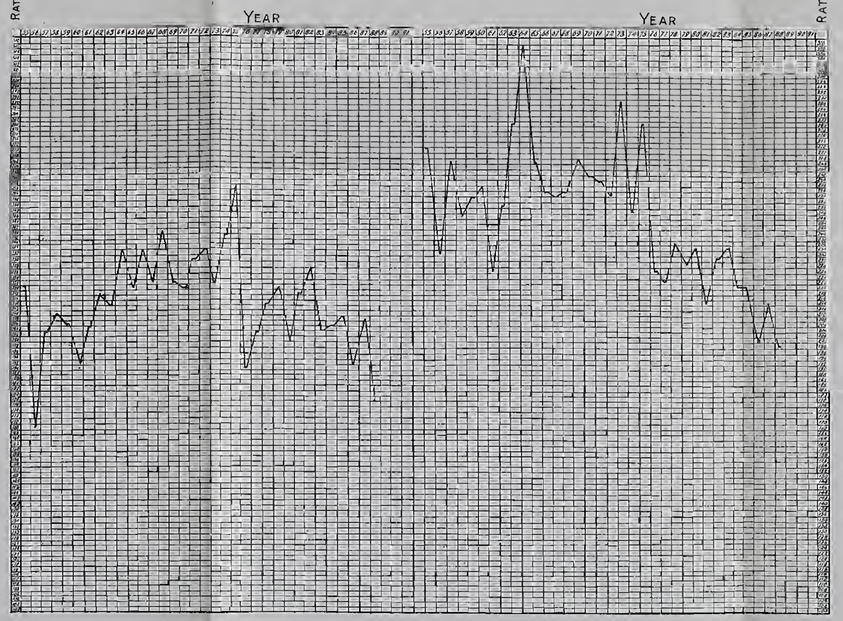
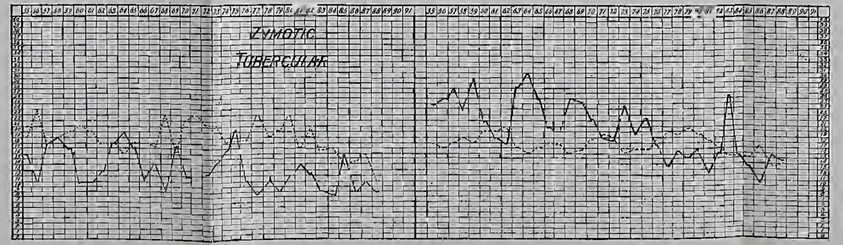
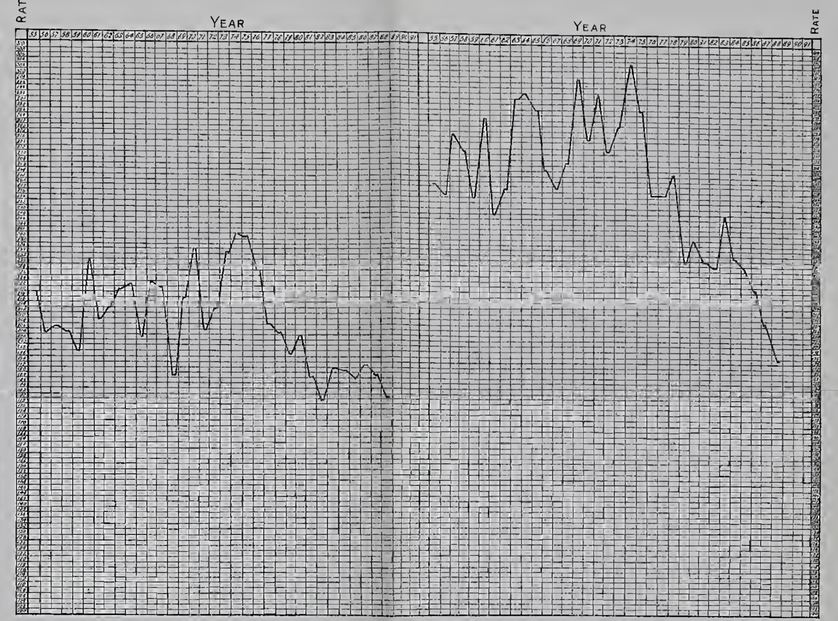


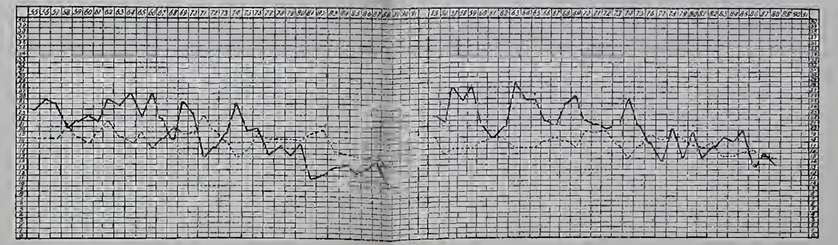
BUTE



RENFREW

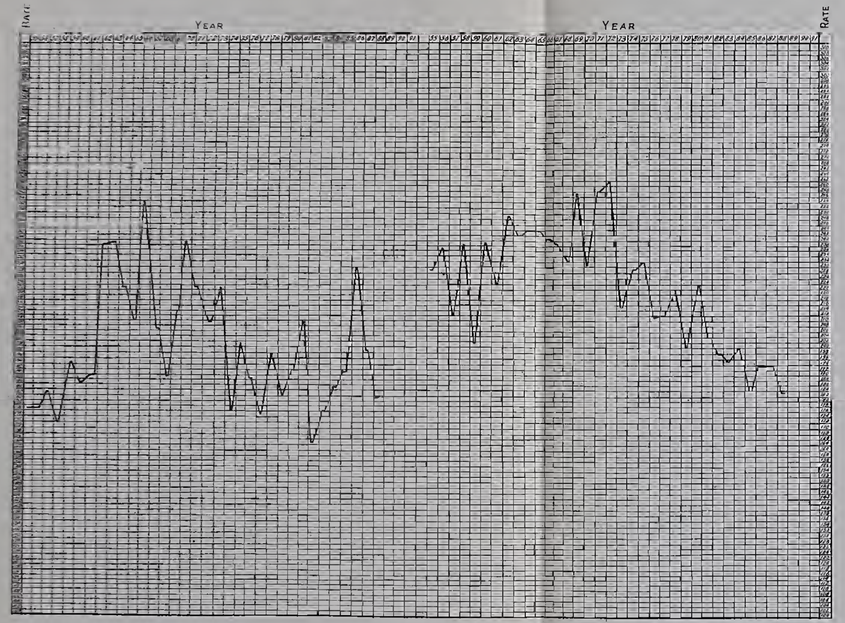


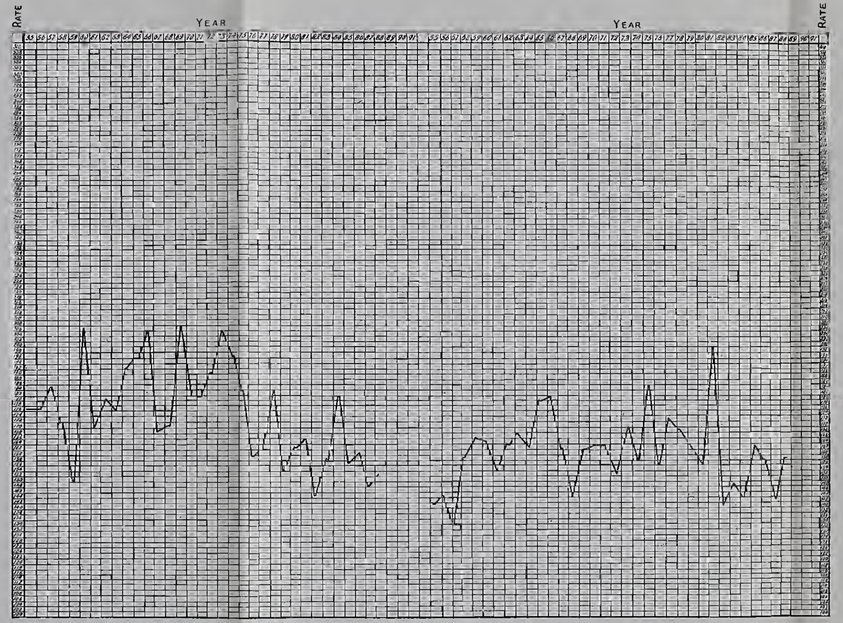
AYR

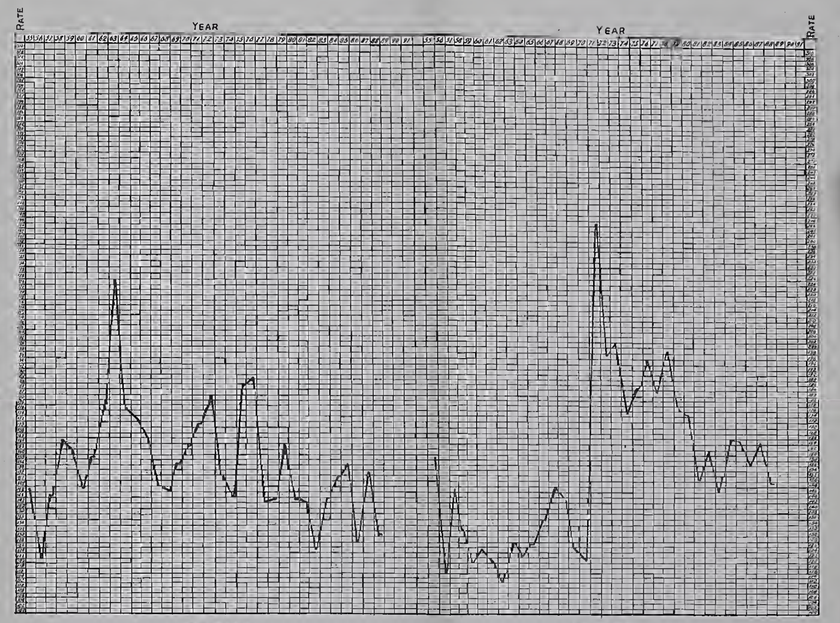


LANARK

Series of Diagrams Showing the Death Rates from all Causes per 10.000 of the Population in Scotland and each of her Counties since 1855, and also the per centage of Zymotic and Tubercular Deaths to Total Deaths.

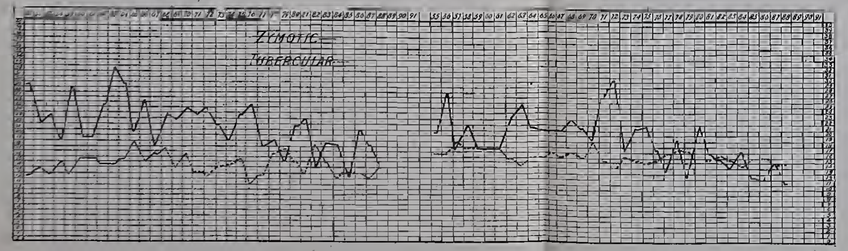






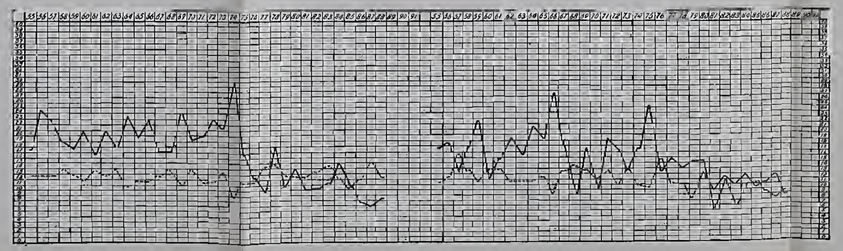
Linlithgow

Edinburgh



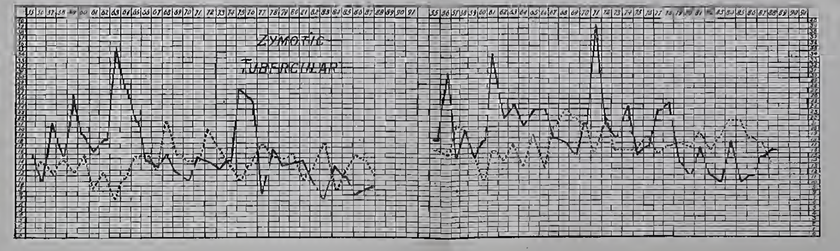
Haddington

Berwick

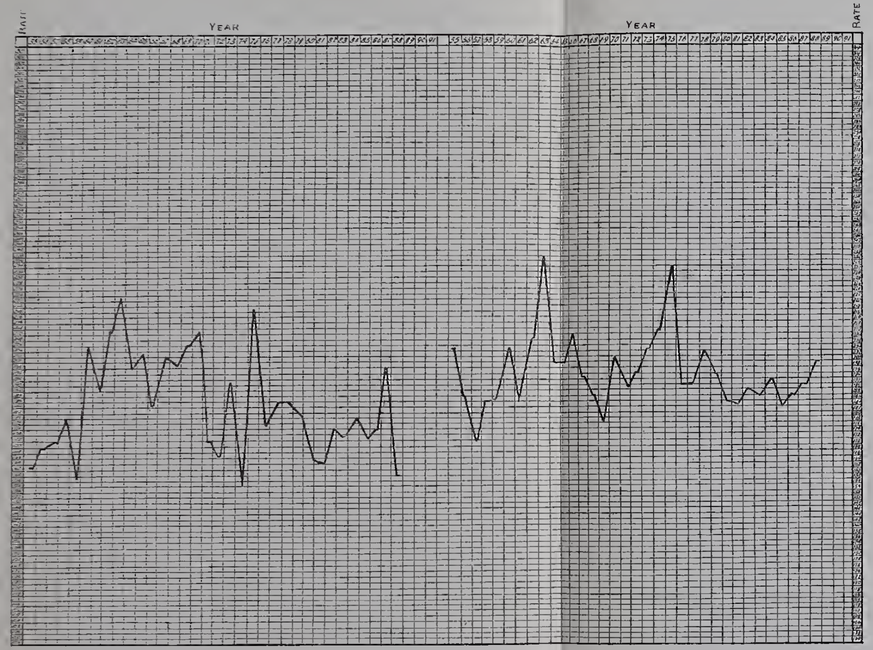


Peebles

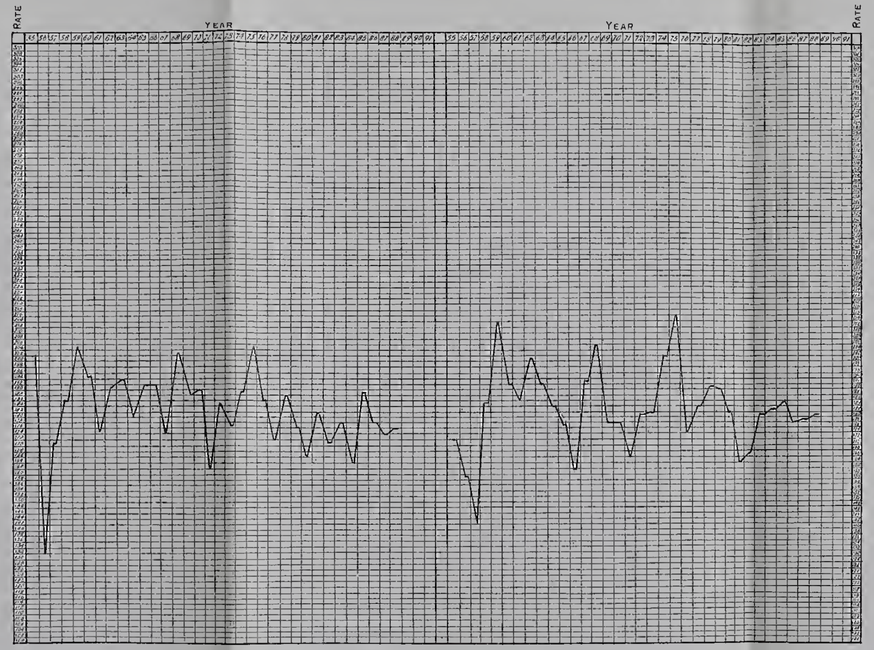
Selkirk



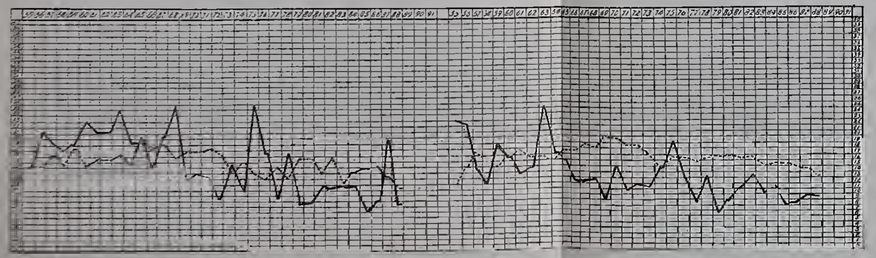
SERIES OF DIAGRAMS SHOWING THE DEATH RATES FROM ALL CAUSES PER 10000 OF THE POPULATION IN SCOTLAND AND EACH OF HER COUNTIES SINCE 1855. AND ALSO THE PER CENTAGE OF ZYMOTIC AND TUBERCULAR DEATHS TO TOTAL DEATHS.



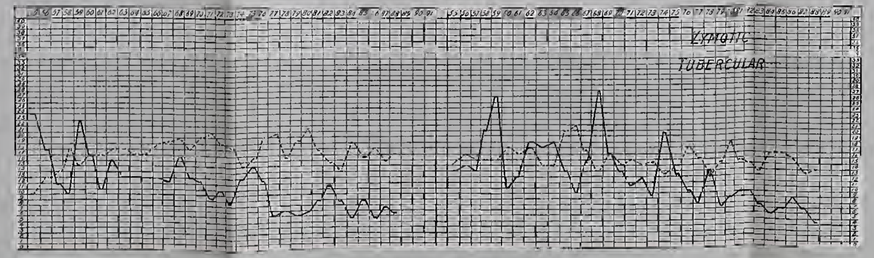
ROXBURGH



DUMFRIES



KIRKCUDBRIGHT



WIGTOWN

TABLE Showing the Average Mortality and Death Rates in the Counties for two Septennials 1855-61 & 1882-88.

	1855 To 1861				1882 To 1888			
	All Causes Rate Per 10000	Zymotic Rate Per 100 Deaths	Tubercular Rate Per 100 Deaths		All Causes Rate Per 10000	Zymotic Rate Per 1000 Deaths	Tubercular Rate Per 1000 Deaths
Scotland	207 28	21 28	16 14		192 85	13 16	14 48
Selkirk	131 14	21 57	16	8	159	13 13	18 36
Orkney	138 43	11 43	13	2	144 57	5 74	11 78
Shetland	146 28	10 57	11 71	10	164 71	6 11	12 91
Caithness	147 14	18	13	12	165 14	8 21	11
Peebles	149 28	17 43	12 57	1	141 43	9 54	13 23
Berwick	151 71	16 28	12 71	4	151	9 57	11 11
Ross & Cromarty	152 86	14 86	10 42	5	153 57	10 51	9 88
Inverness	153 57	14 14	11 42	13	166 42	9 54	9 47
Kincardine	155 42	19	13 14	3	150 43	10 46	11 24
Sutherland	157 57	9 57	14 14	7	158 71	7 5	12 11
Argyle	161	14 28	13 42	15	168 86	7 67	12 54
Elgin	164	14 57	14 14	17	170 42	9 57	12 94
Kinross	164 56	15 28	12 42	16	170	6 31	10 2
Banff	168 85	17	12 26	9	164 14	11 36	11 26
Clackmann	174 71	16 71	15 85	22	176	13 78	15 84
Haddington	177 14	19	12 14	6	158 28	9 4	12 06
Roxburgh	177 42	19 42	15 86	20	174 57	10 84	13 71
Wigtown	177 71	16 4	16 42	23	178 71	7 47	15 17
Fife	179 14	21	12 14	19	173 71	10 84	12 76
Nairn	179 57	15 14	13 71	11	165 14	8 1	9 51
Kirkcudbright	180 57	16 42	14 86	21	175 71	7 8	16 51
Aberdeen	182	19 71	17	14	166 86	12 44	12 37
Linlithgow	182 42	22 71	13 28	26	189 43	16 17	13 3
Dumfries	190	16 71	15 14	28	190 85	10 07	14 74
Perth	190 71	18 85	13 85	18	173 3	8 46	12 23
Stirling	200	20 14	14 85	25	179 86	13 33	14 11
Bute	201 86	14 71	20 14	31	203 85	10 73	15 64
Dumbarton	205 71	21 71	19	24	179 3	14 66	14 94
Ayr	211	23 28	19 28	27	190 57	13 1	16 23
Forfar	226 71	24 71	14 71	30	193 43	12 01	14 64
Edinburgh	228 28	19 42	16 86	29	192 57	13 31	14 63
Renfrew	260 86	24 86	18 57	32	217 43	16 4	15 47
Lanark	265 86	23 86	17 57	33	224 14	16 84	16 01

DAVID V. WYLLIE ARCHITECT, 95 BATH ST.

TABLE Showing the Population:-Mortality Per 10,000:- and Death Rate per Cent from Zymotic & Tubercular Disease in Scotland & her Counties from 1855 to 1888.

SCOTLAND

SHETLAND

ORKNEY

CAITHNESS

SUTHERLAND

ROSS AND CROMARTY

INVERNESS

NAIRN

ELGIN

BANFF

ABERDEEN

KINCARDINE

FORFAR

PERTH

FIFE

KINROSS

CLACKMANNAN

STIRLING

DUMBARTON

ARGYLL

BUTE

RENFREW

AYR

LANARK

LINLITHGOW

EDINBURGH

HADDINGTON

BERWICK

PEEBLES

SELKIRK

ROXBURGH

DUMFRIES

KIRKCUDBRIGHT

WIGTOWN